

CHIEF NOONDAY

Alternate Weather Conditions

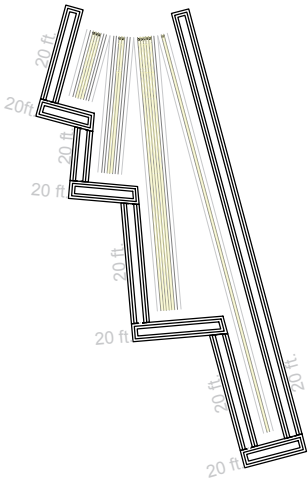
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

Wind: 1 to 11 mph downward

70°F and 50% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure H-8
SA □ Siebein Associates, Inc.

APPENDIX I: COMPUTER MODEL STUDY 4:

Alternate Wind Condition

Site 1 Alternate Range Orientation; Site 2 Base Range Orientation

Typical Day Scenario

20 ft. tall berm

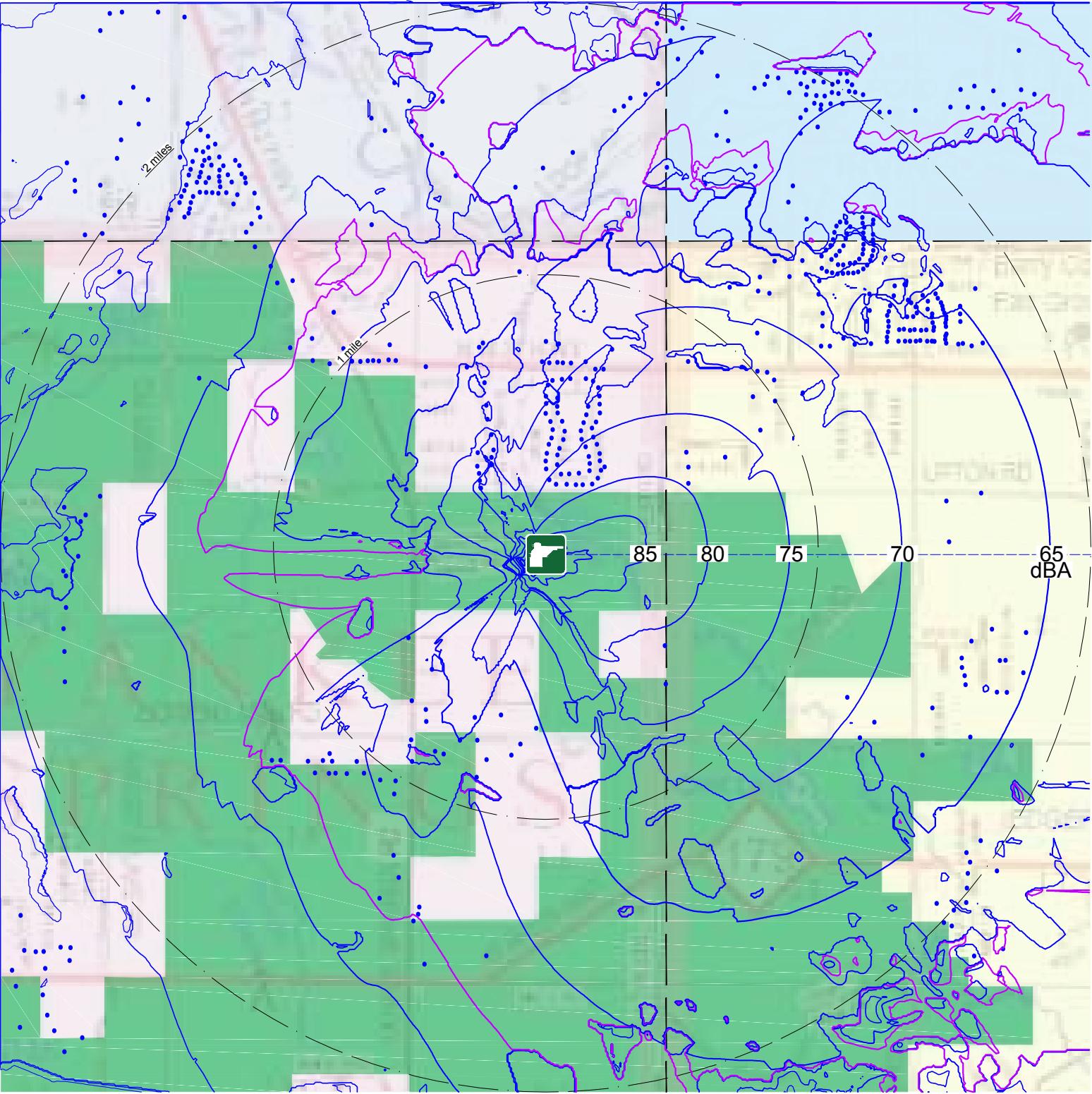
Computer model study 4 was conducted for an alternate wind condition on Site 1: Barry State Game Area Existing Range Site with the direction of fire to the east with the typical day scenario and Site 2: Barry State Game Area Chief Noonday Site with the direction of fire to the south with the typical day scenario.

1. The “typical day” had 5 shooters firing a .223 caliber rifle on the 100 yard range; 1 shooter firing a .223 caliber rifle on the 150 yard range; 2 shooters firing a 12 gauge Remington shotgun on the 50 yard range; and 3 shooters firing a 0.40 caliber handgun on the 25 yard range within a 1 second time period.
2. The wind condition in the base model was modeled as with 1 to 11 mph wind as the other in computer model studies 1 and 2.
3. The 50°F and 70% relative humidity condition was used in the models.
4. The alternate wind condition was 3 miles per hour from the north-northwest which is the average wind speed and direction for this area for a typical year, and 12.8 miles per hour from the southeast for the maximum wind speed and direction in this area.
5. The direction of fire was to the east for Site 1 and to the south for Site 2.
6. The berm height of 10 ft. was used in each of the models.
7. The sound levels shown on the noise contour maps are LA eq in dBA.

The base scenario for wind speed was a 1-11 mile per hour (m.p.h.) wind in a downwind path was used as the base wind condition in the computer model experiments. Computer model study 4 demonstrates that the downwind condition is a worst case condition compared to the 3 m.p.h. wind from the north-northwest which is the average wind speed and direction for wind in the area. The downwind conditions also showed greater impacts on properties in the vicinity of the range than the maximum wind speed and direction at Site 1: Barry State Game Area Existing Range Site and Site 2: Barry State Game Area Chief Noonday Site.

Table I-1. Summary table of rating points for each scenario tested in Experiment 4.

| TYPICAL DAY 3 SHOOTERS 20 FT BERM WIND SPEED AND DIRECTION | | | | | |
|--|-----|----------------------------------|-----------|----|-----|
| Site | DOF | Wind Speed and Direction | Lin Press | dB | PTS |
| SITE 2: Chief Noonday | S | Maximum Wind Speed and Direction | 274 | 74 | 299 |
| SITE 2: Chief Noonday | S | Average Wind Speed and Direction | 317 | 75 | 302 |
| SITE 2: Chief Noonday | S | 1-11 mph downwind | 359 | 76 | 354 |
| SITE 1: Barry SGA | E | Average Wind Speed and Direction | 705 | 78 | 915 |
| SITE 1: Barry SGA | E | Maximum Wind Speed and Direction | 762 | 79 | 928 |
| SITE 1: Barry SGA | E | 1-11 mph downwind | 991 | 80 | 993 |



BARRY SGA
Average Wind Speed and Direction

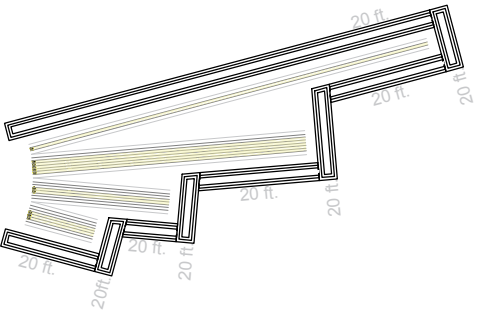
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

Wind: 3 mph; north-northwest

50°F and 70% R.H.










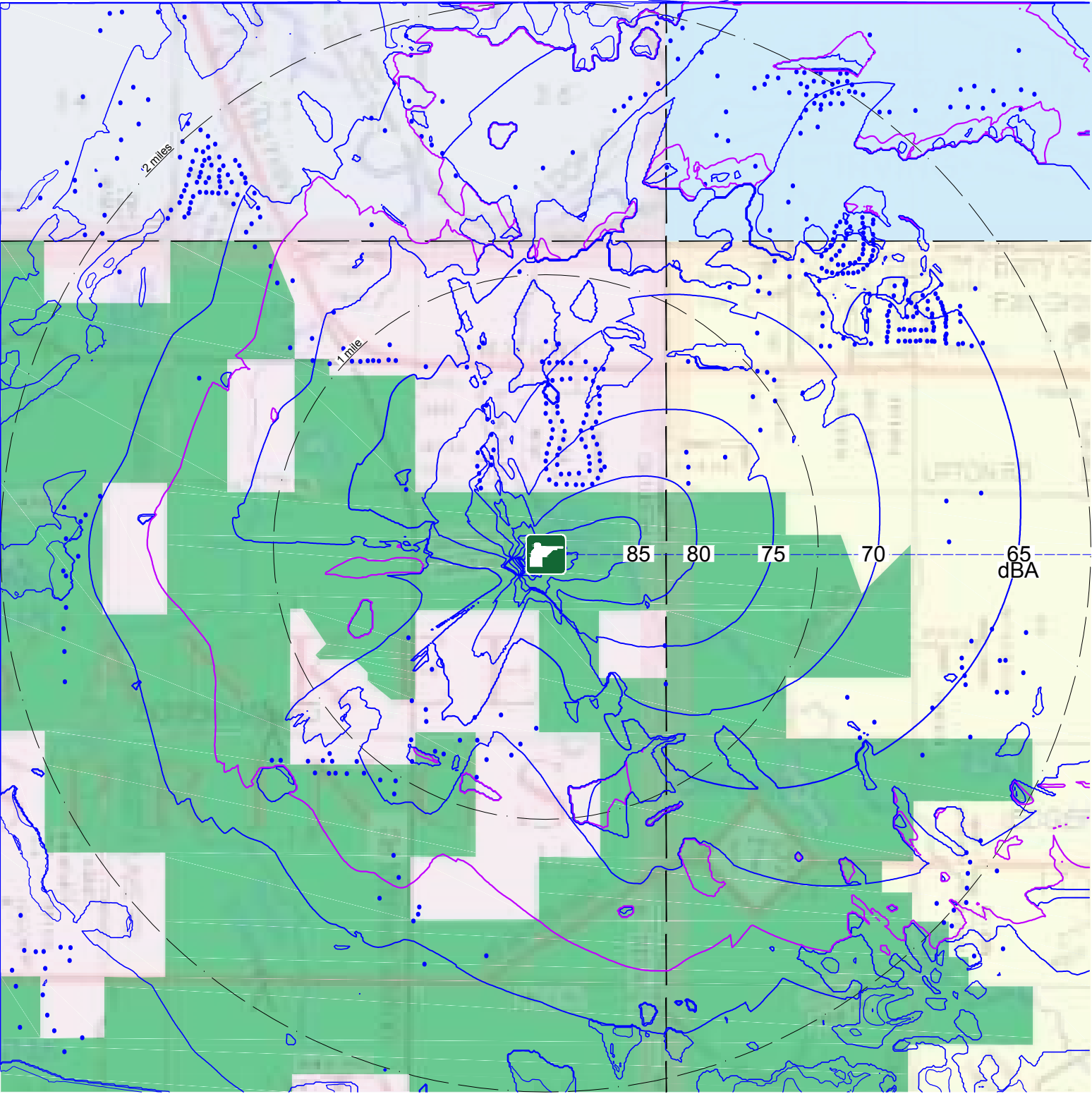
- | | |
|---|---|
|  STATE GAME AREA | |
|  THORNAPPLE TOWNSHIP No sound level limitations established |  YANKEE SPRINGS TOWNSHIP No sound level limitations established |
|  IRVING TOWNSHIP Refer to Barry County Zoning Ordinance |  RUTLAND TOWNSHIP No sound level limitations established |
|  57 dBA Residential Zones 60 dBA Commercial 65 dBA Industrial | |
|  BARRY COUNTY ZONING ORDINANCE Sound Level Limitations if site is zoned as Commercial | |

Figure I-1
SA □ Siebein Associates, Inc.



BARRY SGA

Maximum Wind Speed and Direction

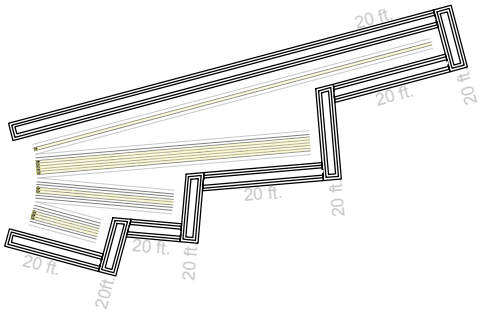
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

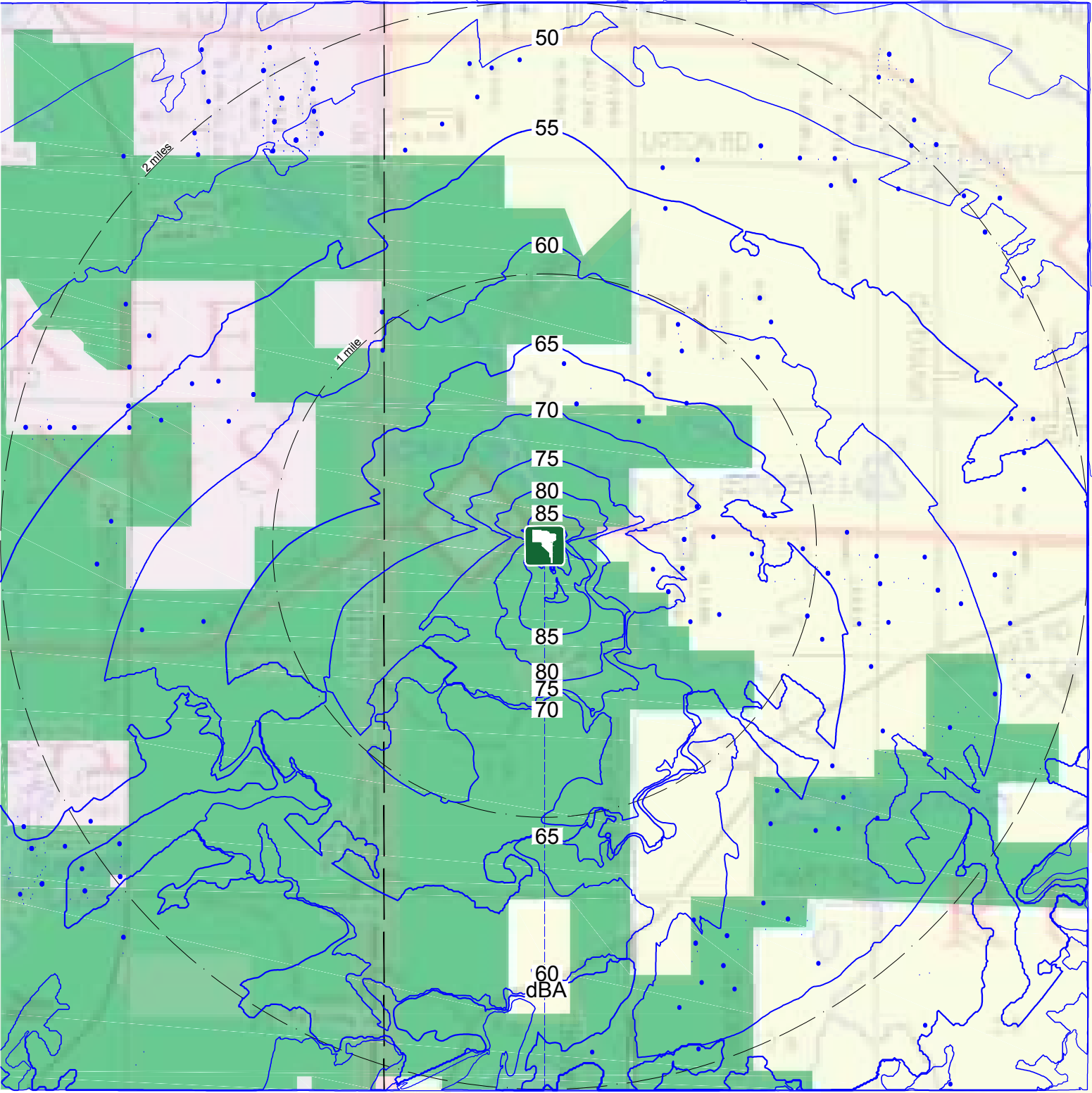
Wind: 12.8 mph; southeast

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure I-2
SA □ Siebein Associates, Inc.



CHIEF NOONDAY
Average Wind Speed and Direction

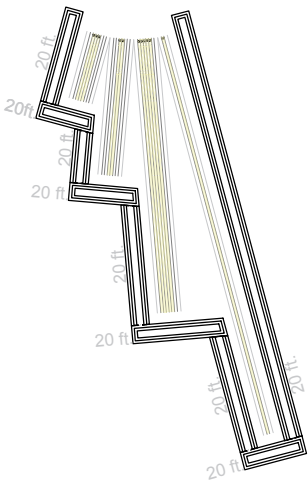
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

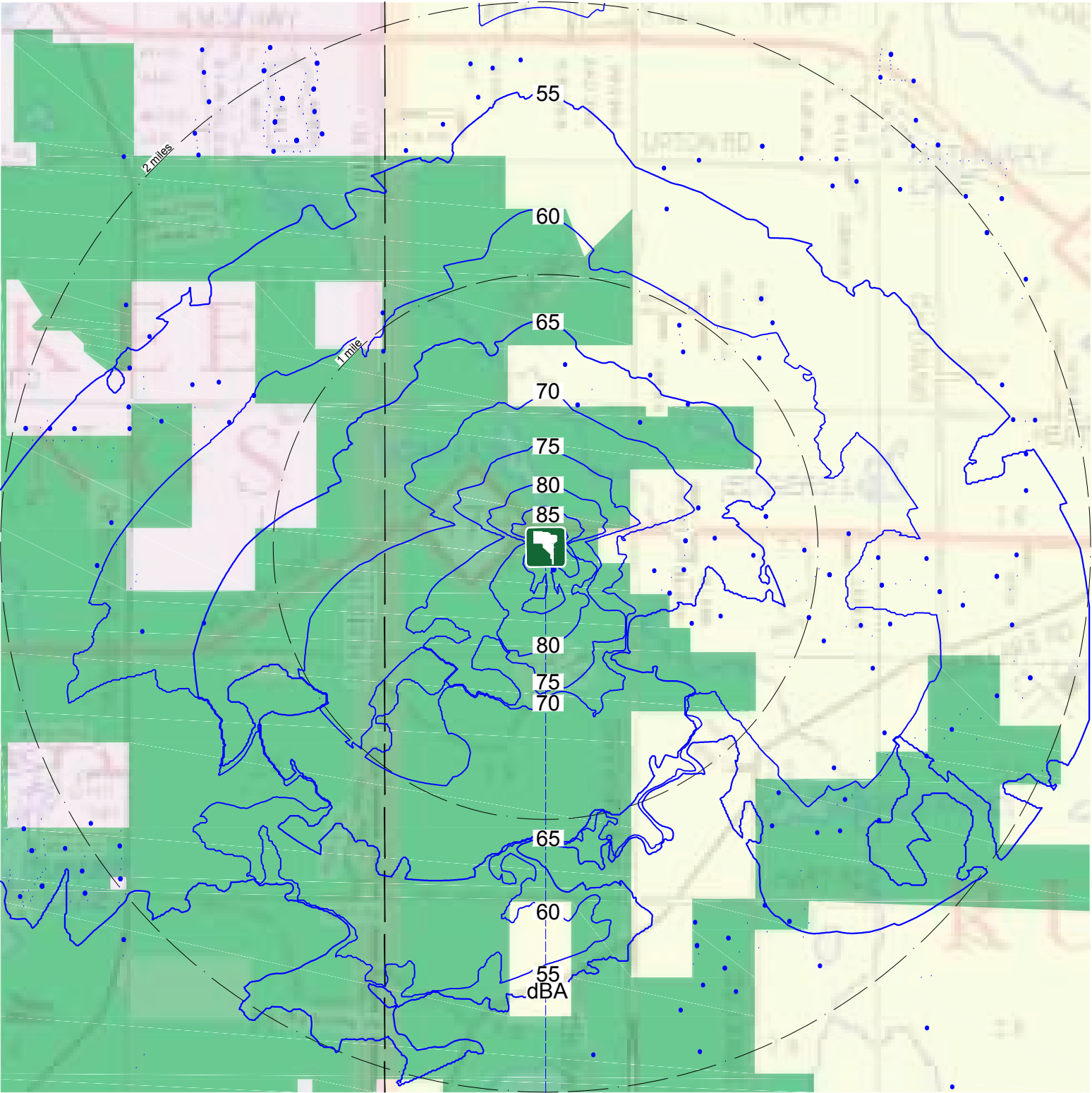
Wind: 3 mph; north-northwest

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure I-3
SA □ Siebein Associates, Inc.



CHIEF NOONDAY

Maximum Wind Speed and Direction

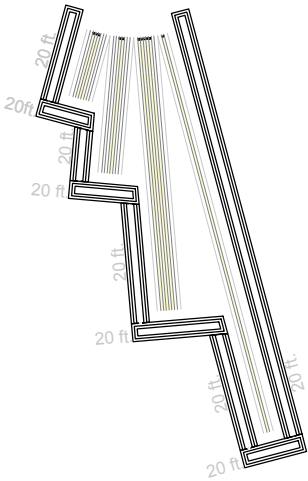
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

Wind: 12.8 mph; southeast

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure I-4
SA □ Siebein Associates, Inc.

APPENDIX J: COMPUTER MODEL STUDY 5:

Coniferous Vegetation Added

Site 1 Alternate Range Orientation; Site 2 Base Range Orientation

Typical Day Scenario

20 ft. tall berm

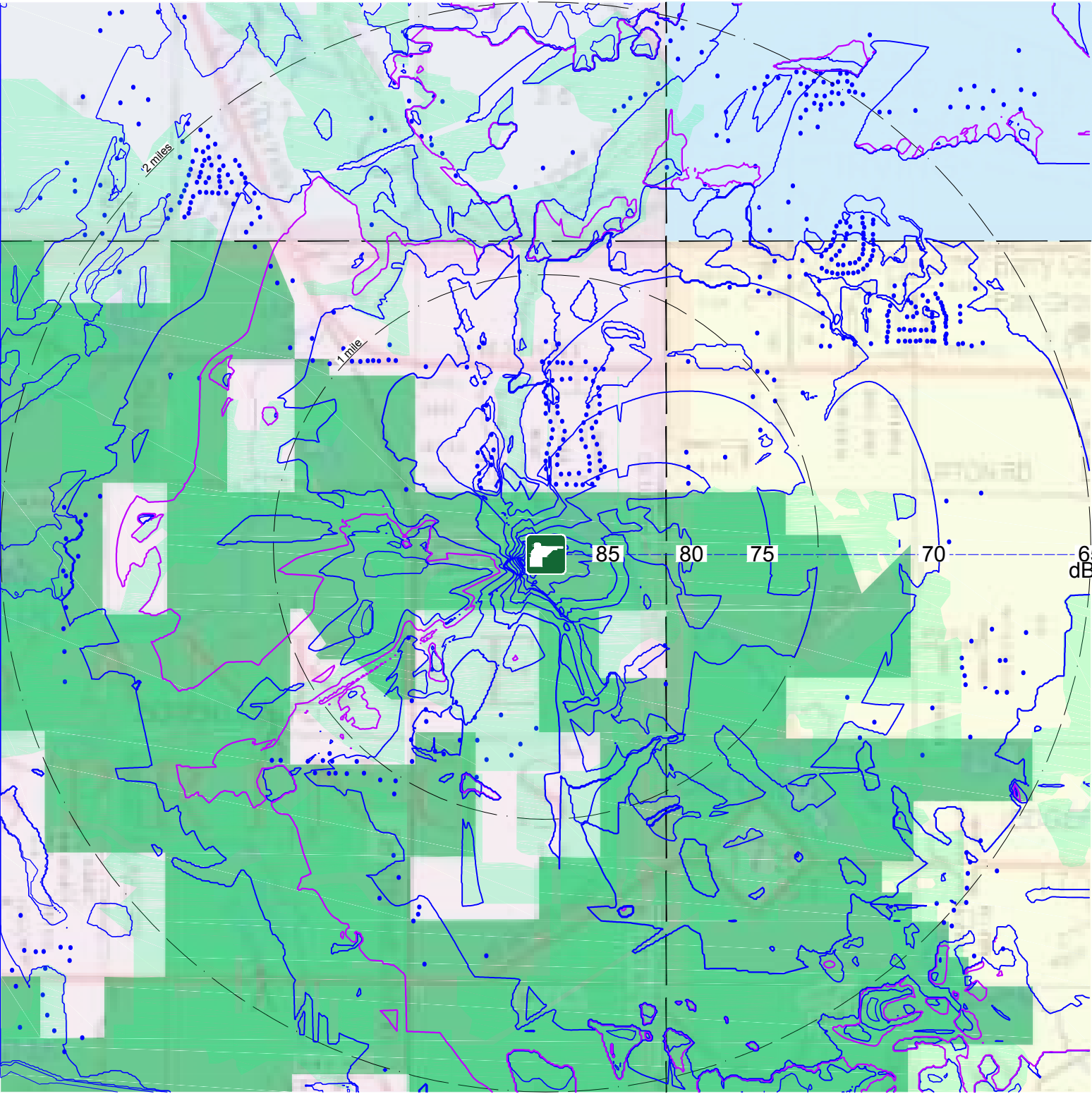
Computer model study 5 was conducted with the coniferous vegetation added on Site 1: Barry State Game Area Existing Range Site with the direction of fire to the east with the typical day scenario and Site 2: Barry State Game Area Chief Noonday Site with the direction of fire to the south with the typical day scenario.

1. The “typical day” had 5 shooters firing a .223 caliber rifle on the 100 yard range; 1 shooter firing a .223 caliber rifle on the 150 yard range; 2 shooters firing a 12 gauge Remington shotgun on the 50 yard range; and 3 shooters firing a 0.40 caliber handgun on the 25 yard range within a 1 second time period.
2. The wind condition in the base model was modeled as downwind with 1 to 11 mph wind as in computer model studies 1 and 2.
3. The 50°F and 70% relative humidity condition was used in the models.
4. A computer model with a temperature of 70°F and 70% relative humidity was also analyzed.
5. The coniferous vegetation was added in areas identified from Google map views during winter months to locate stands of coniferous vegetation in the vicinity of the range sites. It was assumed that the coniferous trees were 30 ft. tall in the computer models.
6. The direction of fire was to the east for Site 1 and to the south for Site 2.
7. The berm height of 20 ft. was used in each of the models.
8. The sound levels shown on the noise contour maps are LA eq in dBA.

The linear pressure score for the addition of stands of coniferous trees (vegetation) at Site 2: Chief Noonday with the range oriented to the south decreased by approximately 86% to 92% compared to the base range model that did not have stands of coniferous vegetation included. The linear pressure score at Site 1: Barry SGA with the range oriented towards the east decreased by approximately 35% to 45% when the coniferous vegetation was added to the model. This experiment indicates that the models without coniferous vegetation present a worst-case scenario for some conditions.

Table J-1. Summary table of rating points for each scenario tested in Experiment 5.

| TYPICAL DAY 11 SHOOTERS 20 FT BERM VEGETATION | | | | | |
|---|-----|--------------------------|-----------|----|------|
| Site | DOF | Description | Lin Press | dB | PTS |
| SITE 2: Chief Noonday | S | Vegetation 50F, 70% RH | 768 | 79 | 1378 |
| SITE 2: Chief Noonday | S | Vegetation 70F, 70% RH | 1,338 | 81 | 1736 |
| SITE 2: Chief Noonday Reference | S | No Vegetation | 4,630 | 87 | 1785 |
| SITE 1: Barry SGA | E | Vegetation 70F, 70% RH | 39,132 | 96 | 1871 |
| SITE 1: Barry SGA | E | Vegetation 50F, 70% RH | 46,066 | 97 | 2413 |
| SITE 1: Barry SGA Reference | E | No Vegetation | 59,135 | 98 | 2140 |



BARRY SGA
Coniferous Vegetation

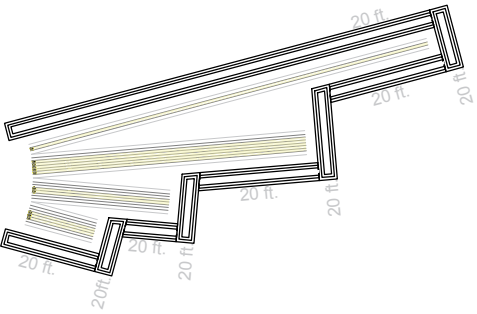
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

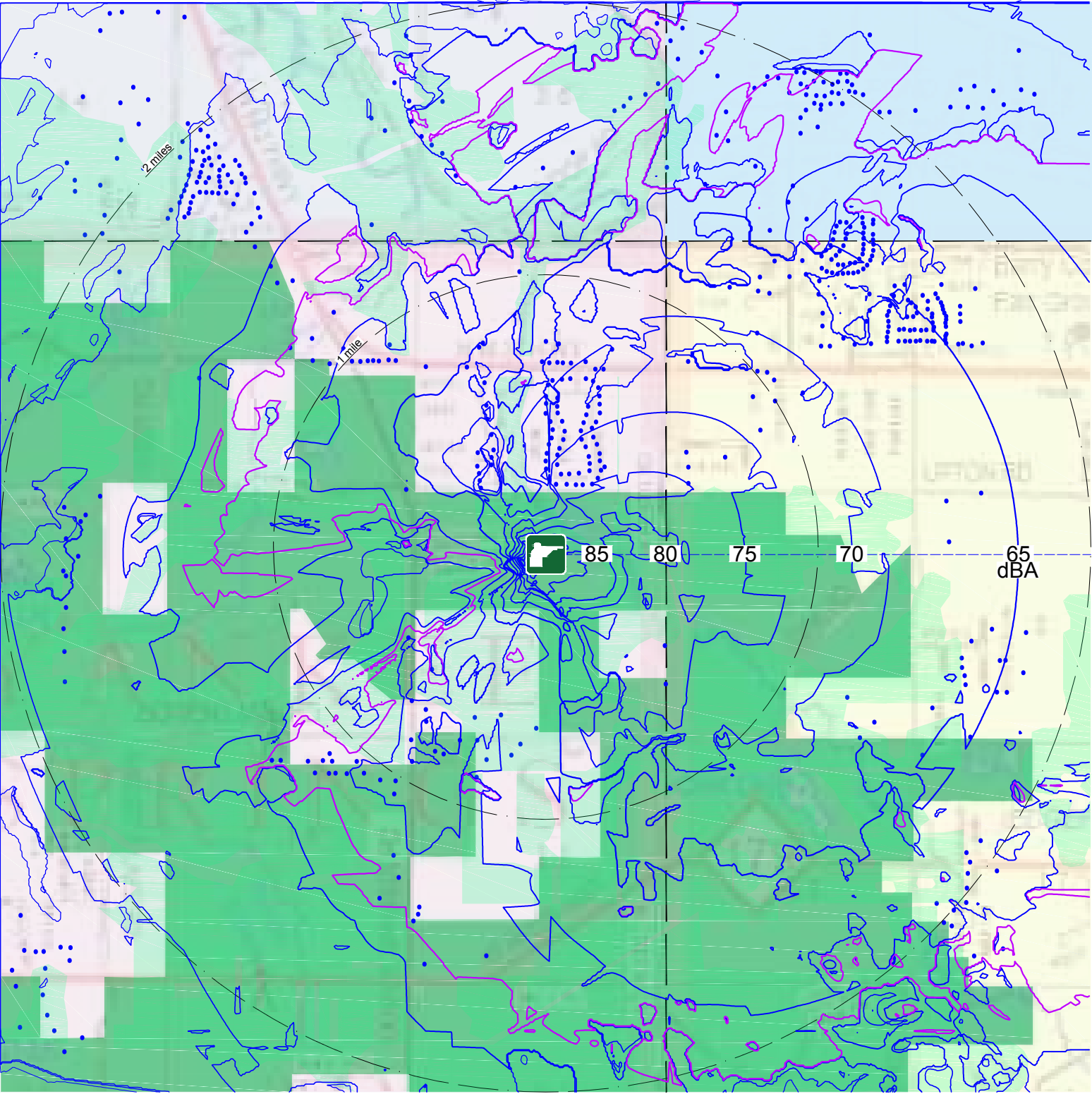
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure J-1
SA □ Siebein Associates, Inc.



BARRY SGA
Coniferous Vegetation

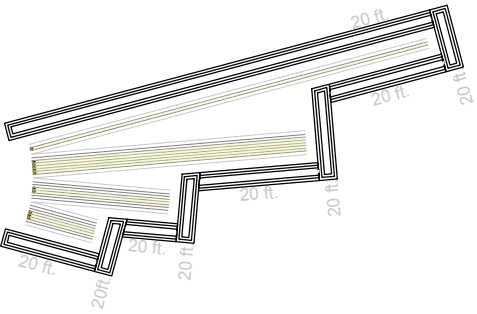
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

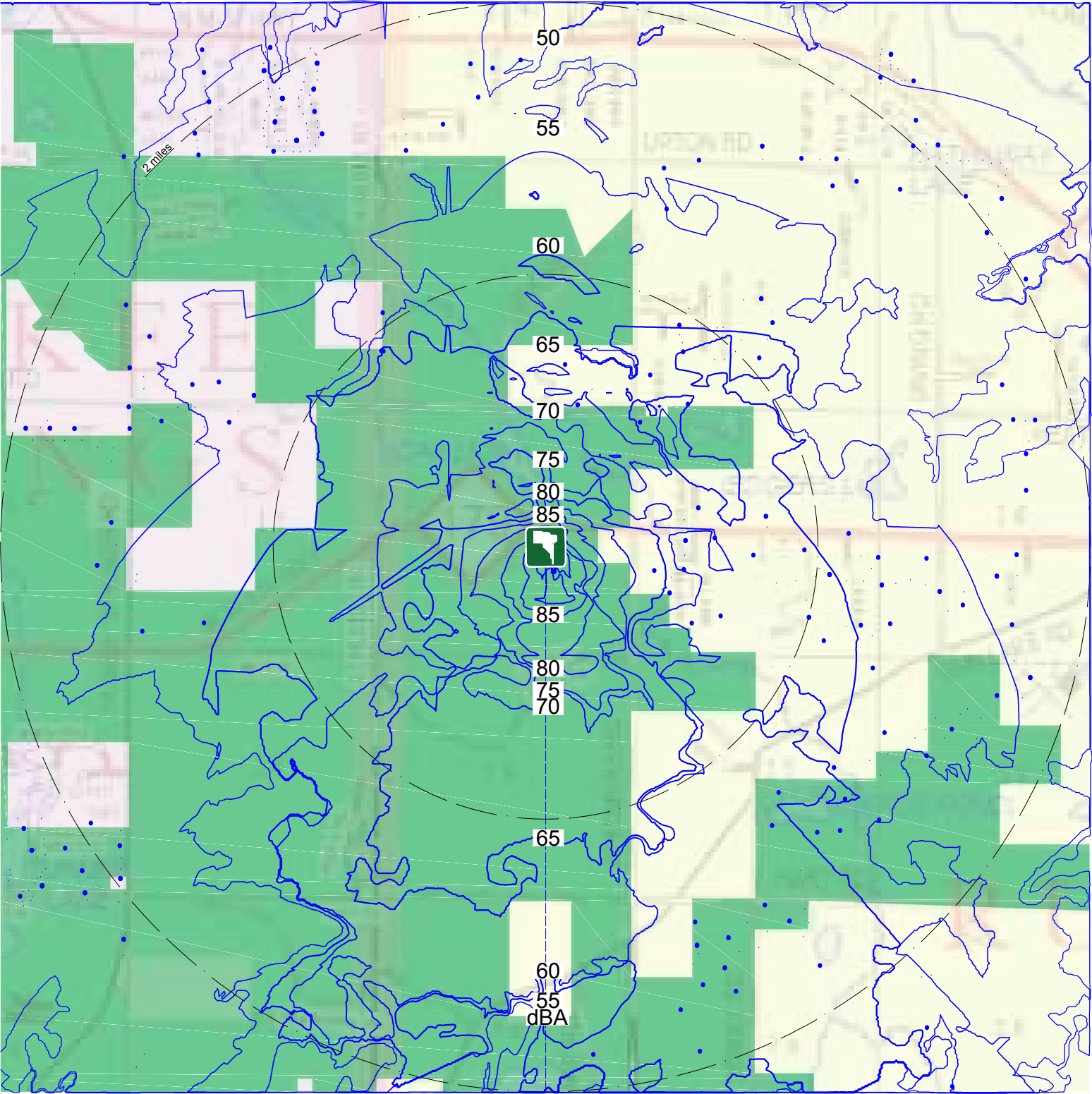
Wind: 1 to 11 mph downward

70°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure J-2
SA □ Siebein Associates, Inc.



CHIEF NOONDAY

Coniferous Vegetation

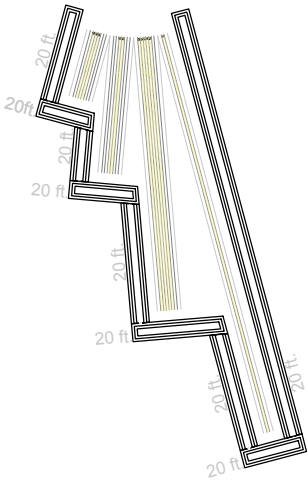
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

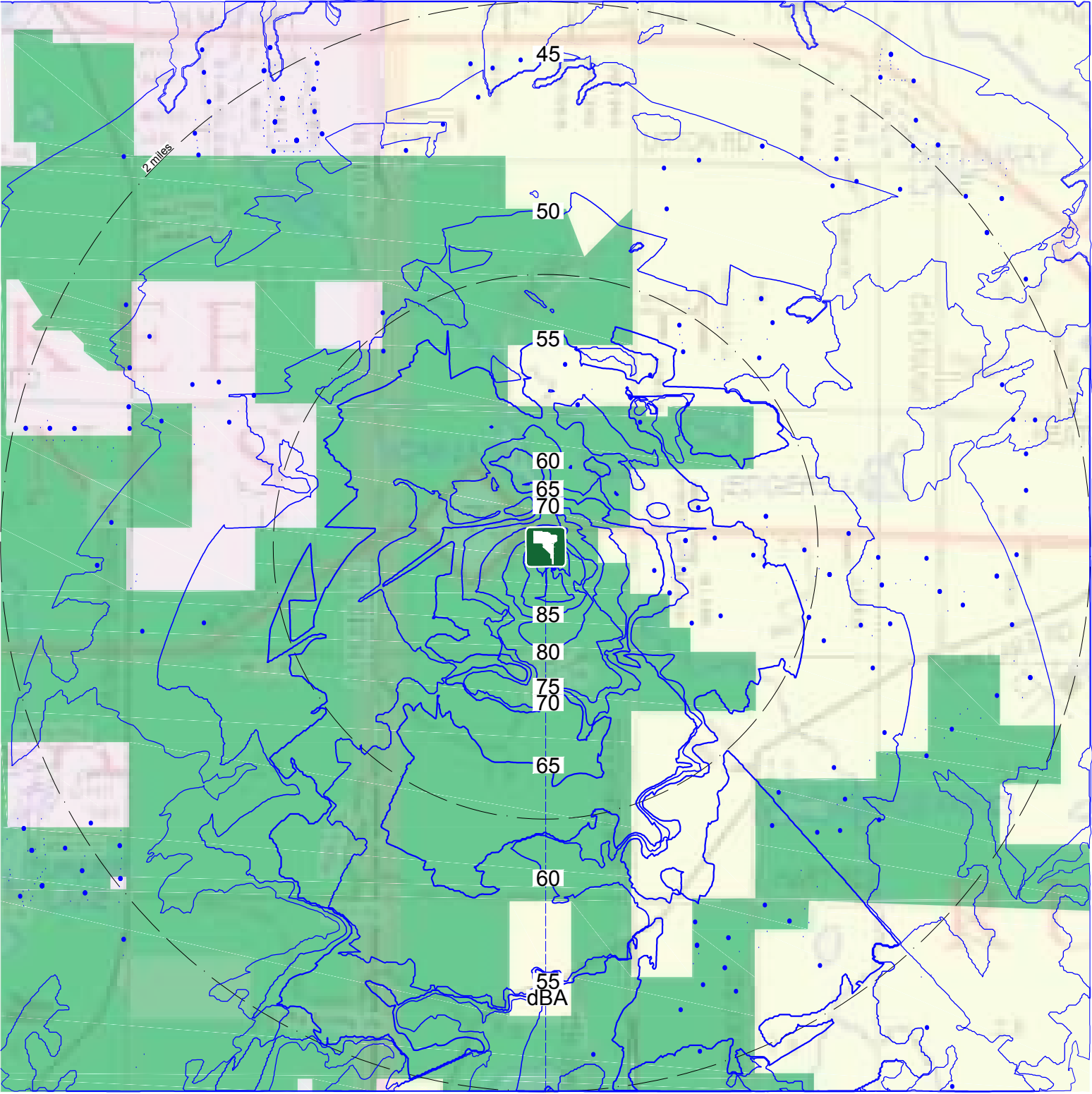
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure J-3
SA □ Siebein Associates, Inc.



CHIEF NOONDAY

Coniferous Vegetation

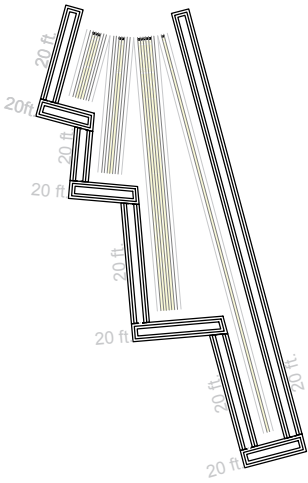
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

Wind: 1 to 11 mph downward

70°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

APPENDIX K: COMPUTER MODEL STUDY 6:

U-Shaped Berm at the Rear of the Range Added

Site 1 Alternate Range Orientation; Site 2 Base and Alternate Range Orientation

Typical Day Scenario

20 ft., and 30 ft. tall berms

Computer model study 6 was conducted with a U-shaped berm at the rear of the range added on Site 1: Barry State Game Area Existing Range Site with the direction of fire to the east and southwest with the typical day scenario and Site 2: Barry State Game Area Chief Noonday Site with the direction of fire to the south and southwest with the typical day scenario.

1. The “typical day” had 5 shooters firing a .223 caliber rifle on the 100 yard range; 1 shooter firing a .223 caliber rifle on the 150 yard range; 2 shooters firing a 12 gauge Remington shotgun on the 50 yard range; and 3 shooters firing a 0.40 caliber handgun on the 25 yard range within a 1 second time period.
2. The wind condition in the base model was modeled as downwind with 1 to 11 mph wind as in computer model studies 1 and 2.
3. The 50°F and 70% relative humidity condition was used in the models.
4. A U-shaped berm was added at the rear of the range with a slot between the rear berm and the front berm to allow people to access the range.
5. The direction of fire was to the east and southwest for Site 1 and to the south and southwest for Site 2.
6. The berm height of 20 ft. was used in the reference model.
7. The U-shaped berm was modeled at 20 ft. tall and 30 ft. tall at Site 1 and Site 2.
8. The sound levels shown on the noise contour maps are LA eq in dBA.

Increasing the height of the berms to 20 ft. tall and 30 ft. tall respectively and including a berm of similar height in a U-shape around the rear of the range significantly reduces the linear pressure and dB scores for the ranges at Site 1: Barry SGA and Site 2: Chief Noonday.

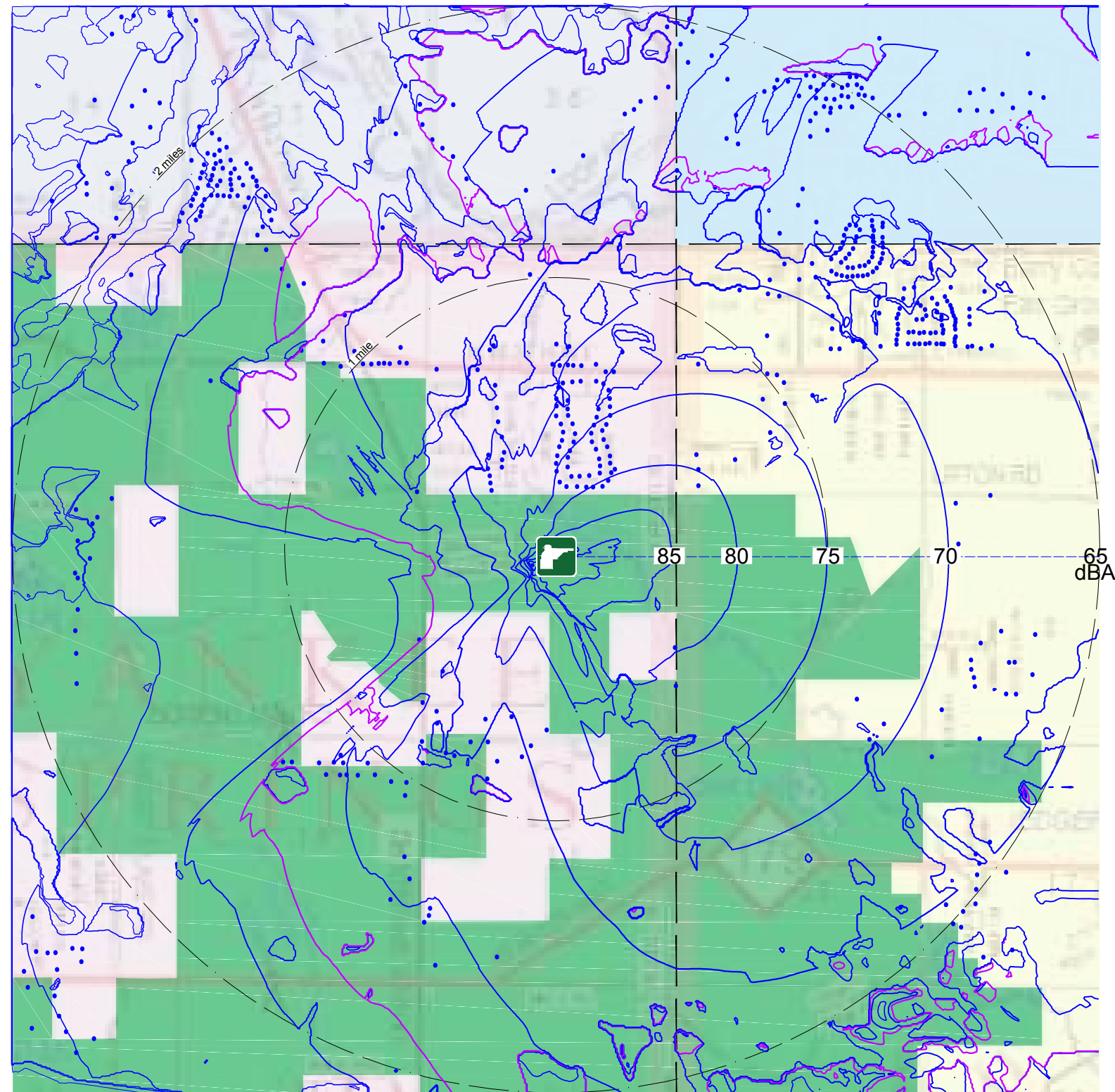
The linear pressure score is decreased by 60% to 65% with the addition of the 20 ft. tall berm and the U-shaped berm at the rear of the range at Site 2: Chief Noonday for a range orientation to the southwest and to the south respectively; and by an additional 75% to 76% when the downrange berms and rear berms are increased to 30 ft. tall for the south and southwest range orientation at Site 2.

The linear pressure score is decreased by almost 30% with the addition of the 20 ft. tall berm and the U-shaped berm at the rear of the range and by an additional almost 60% when the down range berm and rear berms are increased to 30 ft. tall for the east range orientation at Site 1: Barry SGA. Orienting the range to the southwest allows for a further reduction in the linear pressure score by almost 70% with the addition of the 20 ft. tall berm and the U-shaped berm at the rear of the range and by an additional almost 80% when the down range berm and rear berms are increased to 30 ft.

The rough order of magnitude cost increase for extending the berm height to 20 ft. tall and including the U-shaped berm at the rear of the range is approximately \$349,600. The rough order of magnitude cost increase for extending the berm height to 30 ft. tall and including the U-shaped berm at the rear of the range is approximately \$1,169,300.

Table K-1. Summary table of rating points for each scenario tested in Experiment 6.

| TYPICAL DAY 11 SHOOTERS U-SHAPED BERM AT REAR OF RANGE | | | | | |
|---|------------|----------------------|------------------|-----------|------------|
| Site | DOF | Berm Height | Lin Press | dB | PTS |
| SITE 2: Chief Noonday | SW | 30 FT. U-Shaped Berm | 2,301 | 84 | 1595 |
| SITE 2: Chief Noonday | S | 30 FT. U-Shaped Berm | 2,365 | 84 | 1617 |
| SITE 2: Chief Noonday | SW | 20 FT. U-Shaped Berm | 3,411 | 85 | 1754 |
| SITE 2: Chief Noonday | S | 20 FT. U-Shaped Berm | 3,733 | 86 | 1726 |
| SITE 2: Chief Noonday Reference | S | 20 FT. Tall Berm | 4,630 | 87 | 1785 |
| SITE 1: Barry SGA | SW | 30 FT. U-Shaped Berm | 16,417 | 92 | 2303 |
| SITE 1: Barry SGA | SW | 20 FT. U-Shaped Berm | 24,240 | 94 | 2053 |
| SITE 1: Barry SGA | E | 30 FT. U-Shaped Berm | 31,679 | 95 | 2087 |
| SITE 1: Barry SGA | E | 20 FT. U-Shaped Berm | 52,719 | 97 | 1996 |
| SITE 1: Barry SGA Reference | E | 20 FT. Tall Berm | 59,135 | 98 | 2140 |



BARRY SGA

U-Shaped Berm

Shooters within 1 second:

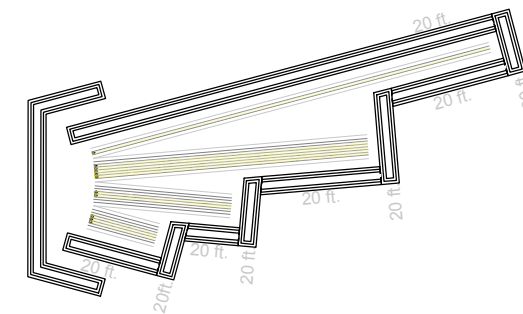
- 6 Rifles
- 2 Shotguns
- 3 Handguns

D.O.F. East

- 20 ft. End Berms
- 20 ft. Side Berms
- 20 ft. U-Shaped Berm

Wind: 1 to 11 mph downward

50°F and 70% R.H.



STATE GAME AREA

THORNAPPLE TOWNSHIP
No sound level limitations established

IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance

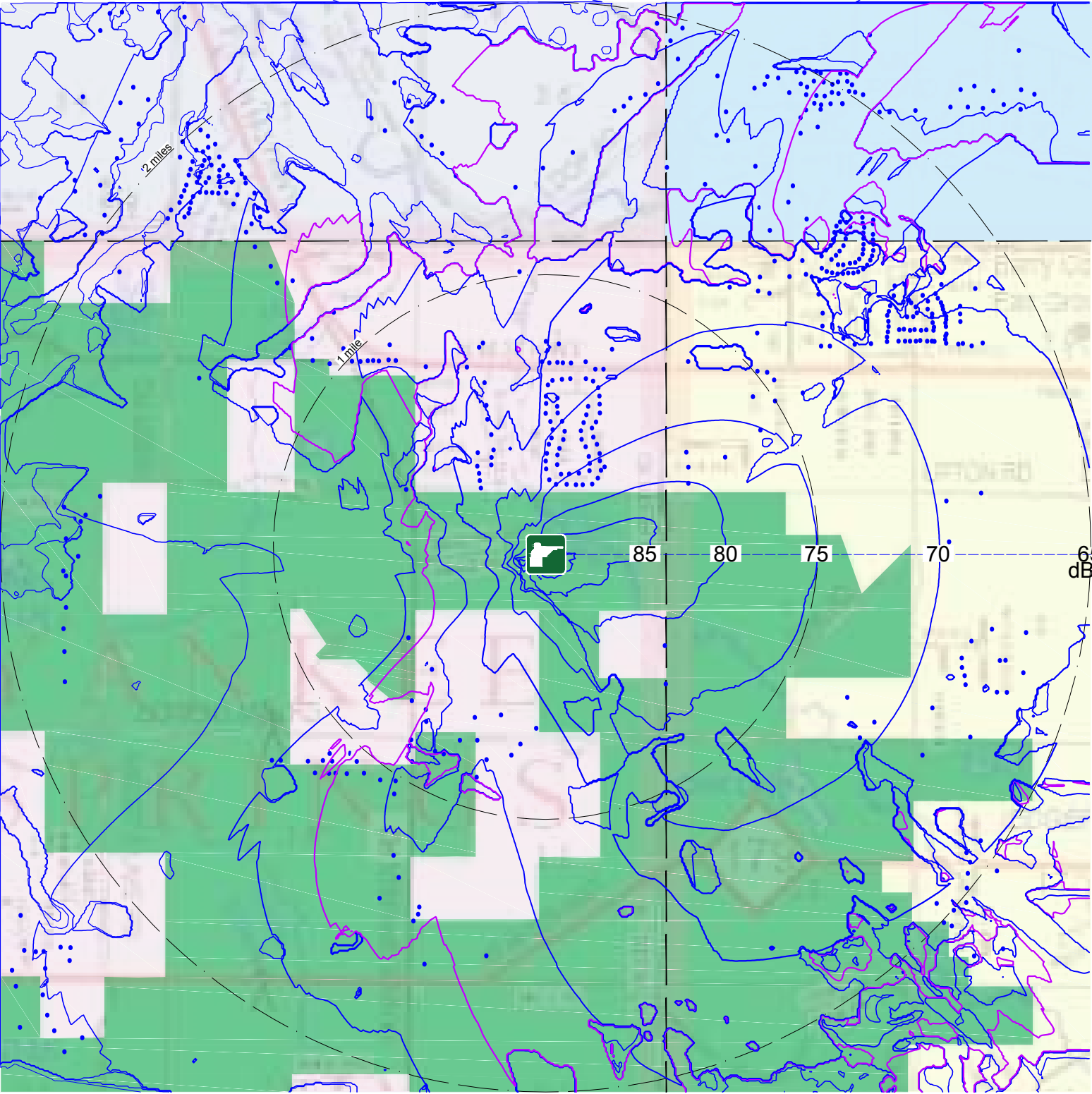
YANKEE SPRINGS TOWNSHIP
No sound level limitations established

RUTLAND TOWNSHIP
No sound level limitations established

57 dBA Residential Zones
60 dBA Commercial
65 dBA Industrial

BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure K-1



BARRY SGA

U-Shaped Berm

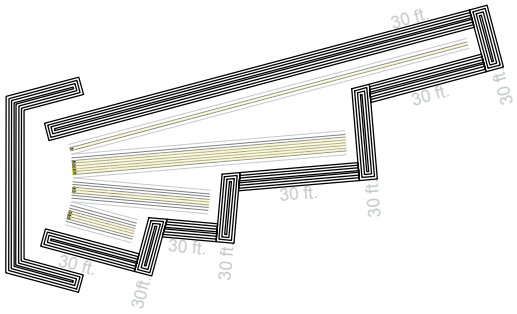
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

30 ft. End Berms
30 ft. Side Berms
30 ft. U-Shaped Berm

Wind: 1 to 11 mph downward

50°F and 70% R.H.












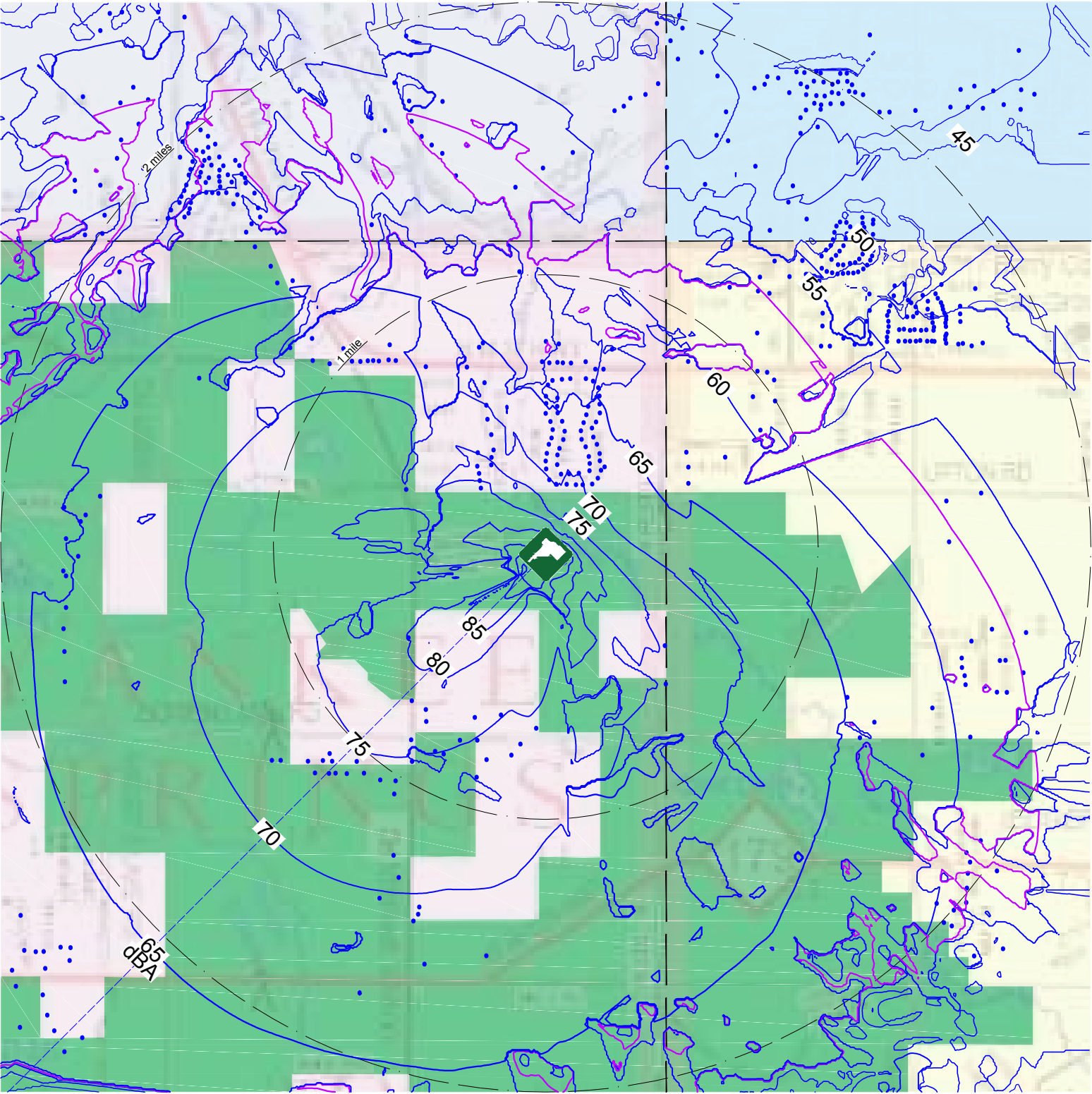
- | | |
|--|---|
|  STATE GAME AREA | |
|  THORNAPPLE TOWNSHIP No sound level limitations established |  YANKEE SPRINGS TOWNSHIP No sound level limitations established |
|  IRVING TOWNSHIP Refer to Barry County Zoning Ordinance |  RUTLAND TOWNSHIP No sound level limitations established |
|  57 dBA Residential Zones  60 dBA Commercial  65 dBA Industrial | |
|  BARRY COUNTY ZONING ORDINANCE Sound Level Limitations if site is zoned as Commercial | |

Figure K-2
SA □ Siebein Associates, Inc.



BARRY SGA

U-Shaped Berm

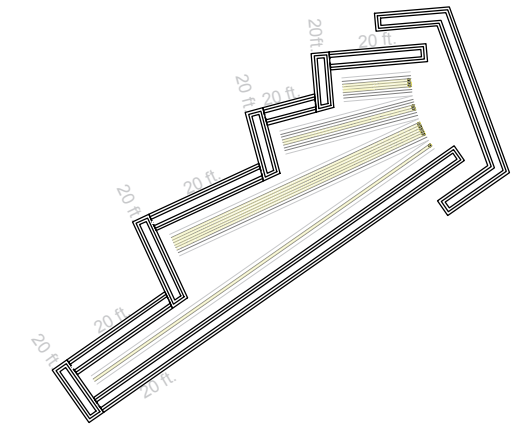
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. SW

20 ft. End Berms
20 ft. Side Berms
20 ft. U-Shaped Berm

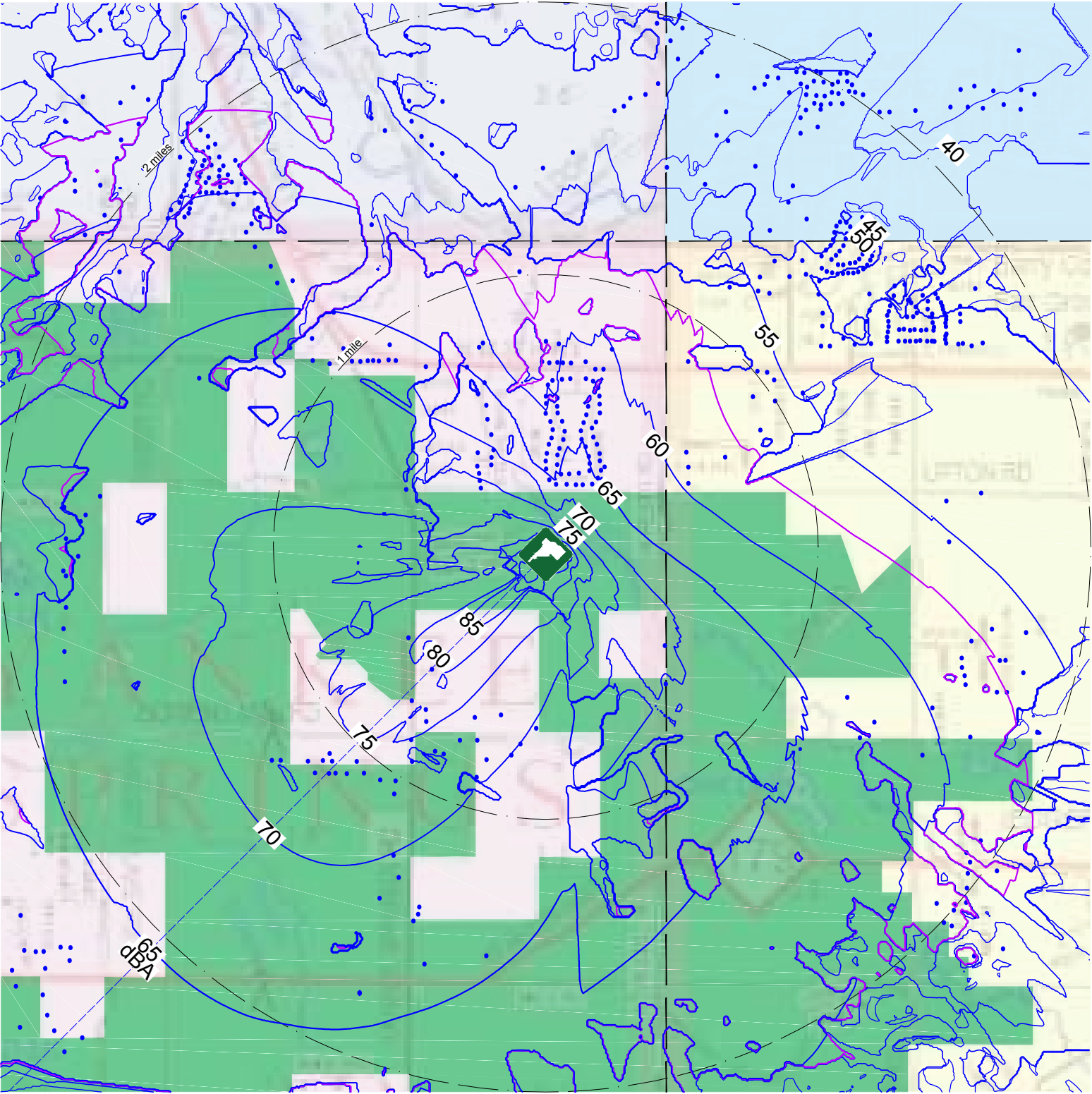
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure K-3
SA □ Siebein Associates, Inc.



BARRY SGA

U-Shaped Berm

Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. SW

30 ft. End Berms
30 ft. Side Berms
30 ft. U-Shaped Berm

Wind: 1 to 11 mph downward

50°F and 70% R.H.

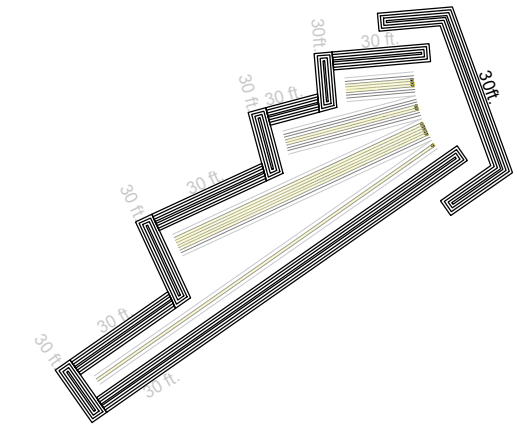
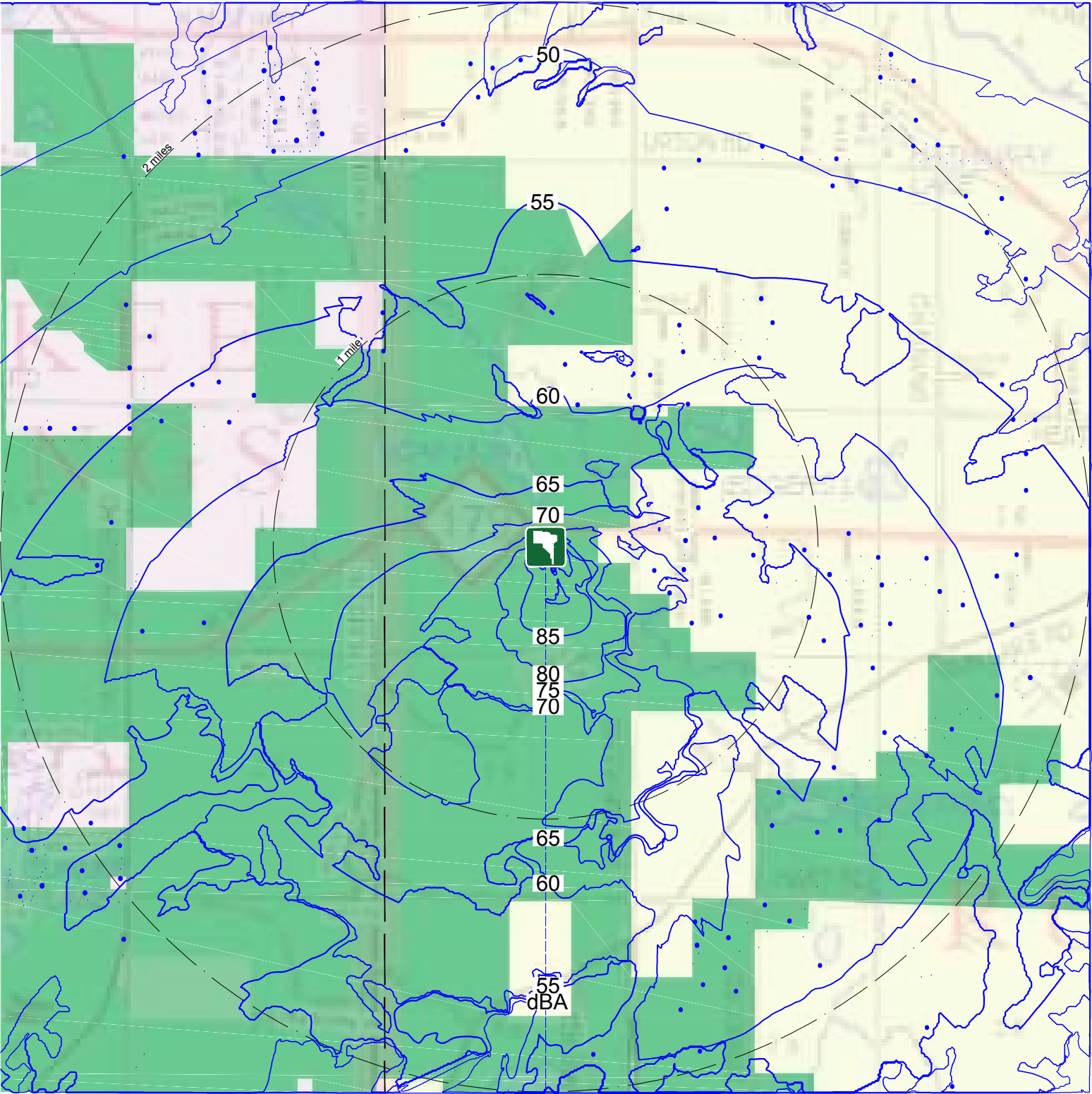


Figure K-4



CHIEF NOONDAY

U-Shaped Berm

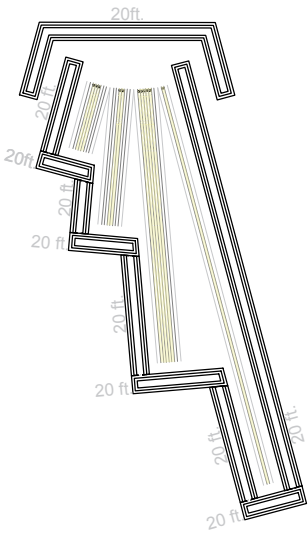
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms
20 ft. U-Shaped Berm

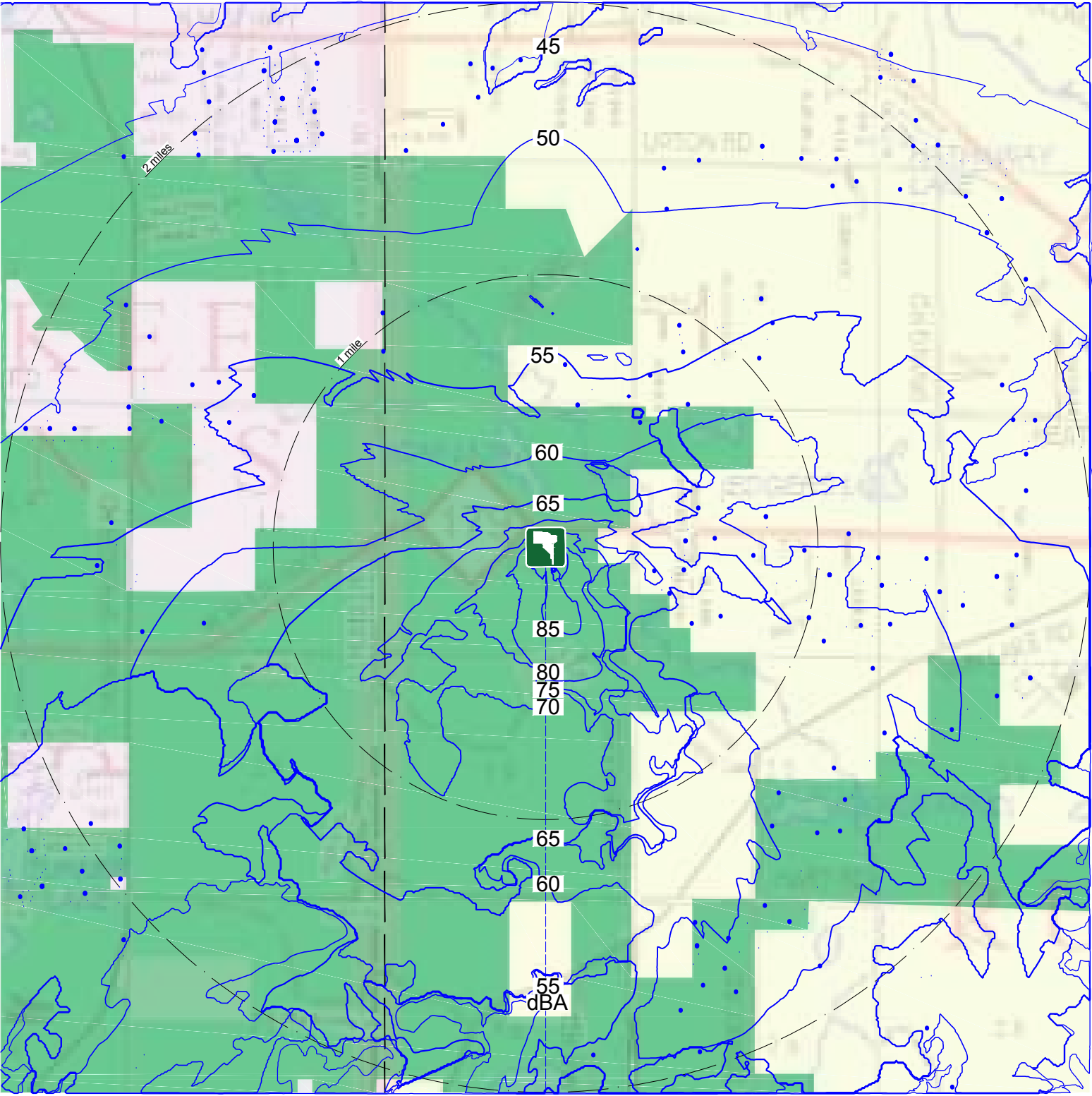
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure K-5
SA □ Siebein Associates, Inc.



CHIEF NOONDAY

U-Shaped Berm

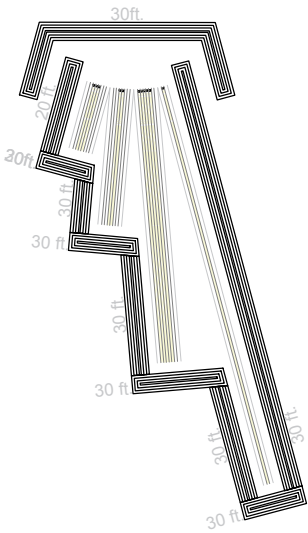
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

30 ft. End Berms
30 ft. Side Berms
30 ft. U-Shaped Berm

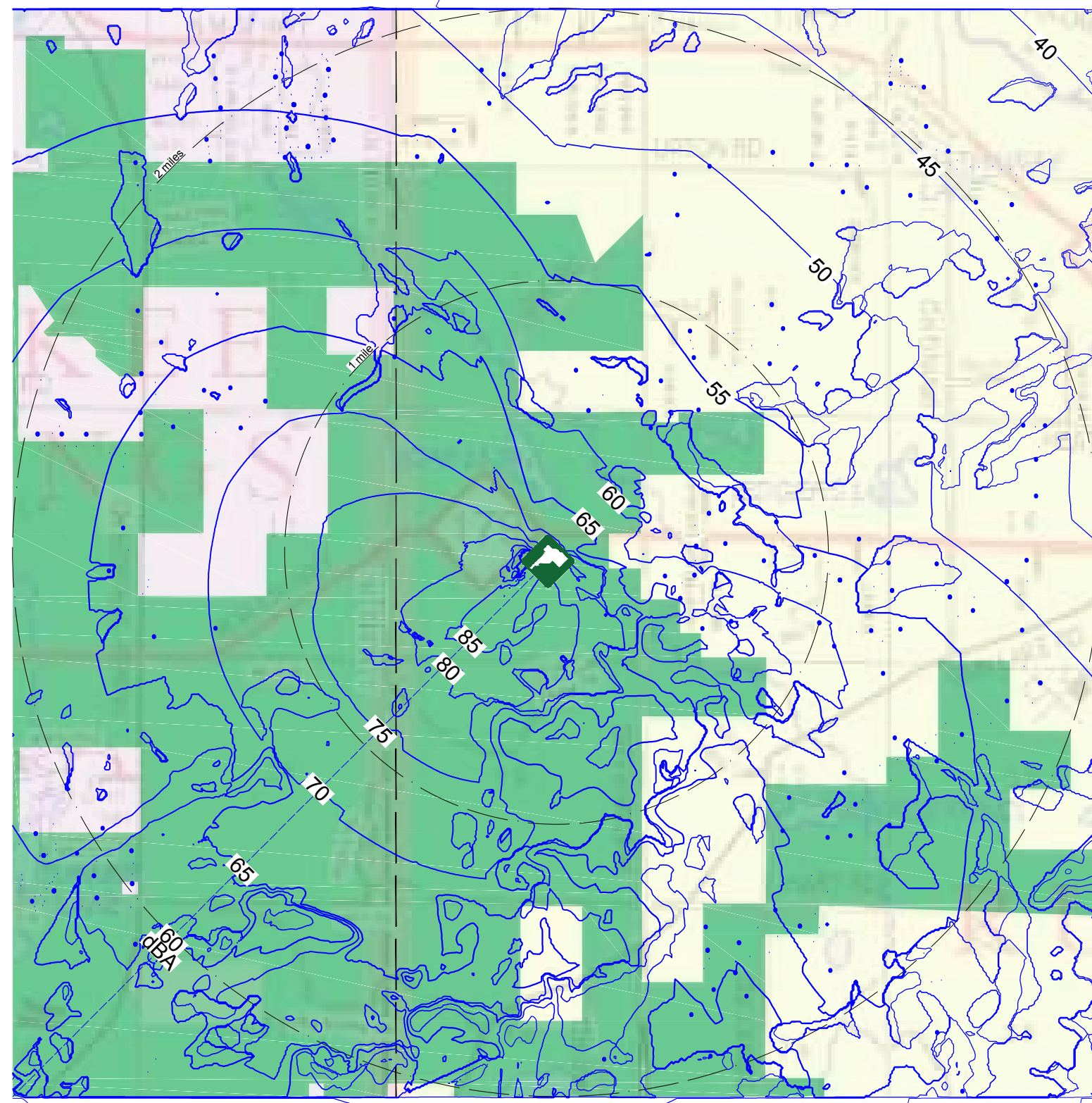
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure K-6
SA □ Siebein Associates, Inc.



CHIEF NOONDAY

U-Shaped Berm

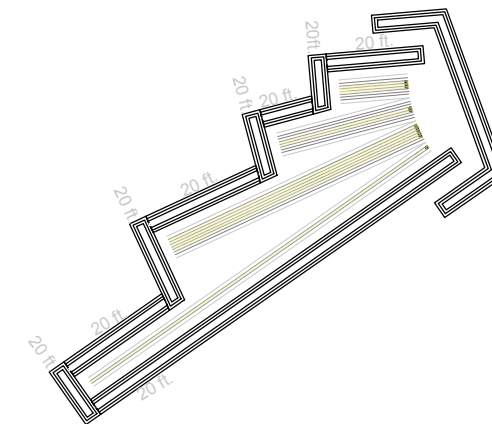
Shooters within 1 second:
 6 Rifles
 2 Shotguns
 3 Handguns

D.O.F. SW

20 ft. End Berms
 20 ft. Side Berms
 20 ft. U-Shaped Berm

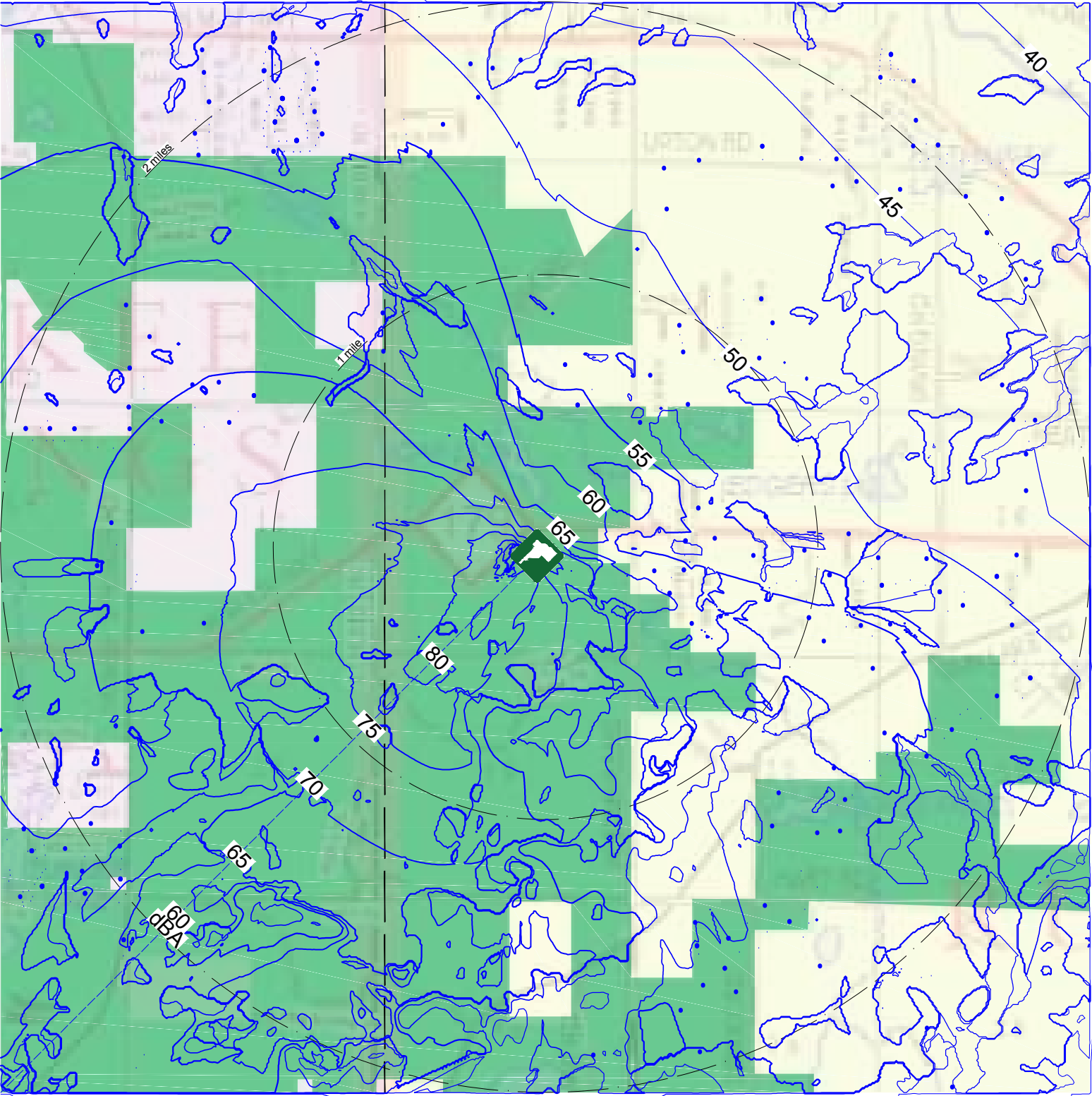
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure K-7



CHIEF NOONDAY

U-Shaped Berm

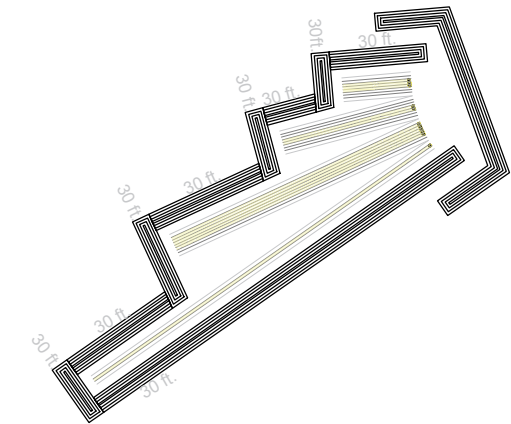
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. SW

30 ft. End Berms
30 ft. Side Berms
30 ft. U-Shaped Berm

Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure K-8
SA □ Siebein Associates, Inc.

APPENDIX L: COMPUTER MODEL STUDY 7:

Sound Absorbing Material Added to the Range

Site 1 Alternate Range Orientation; Site 2 Base and Alternate Range Orientation

Typical Day Scenario

20 ft. tall berm

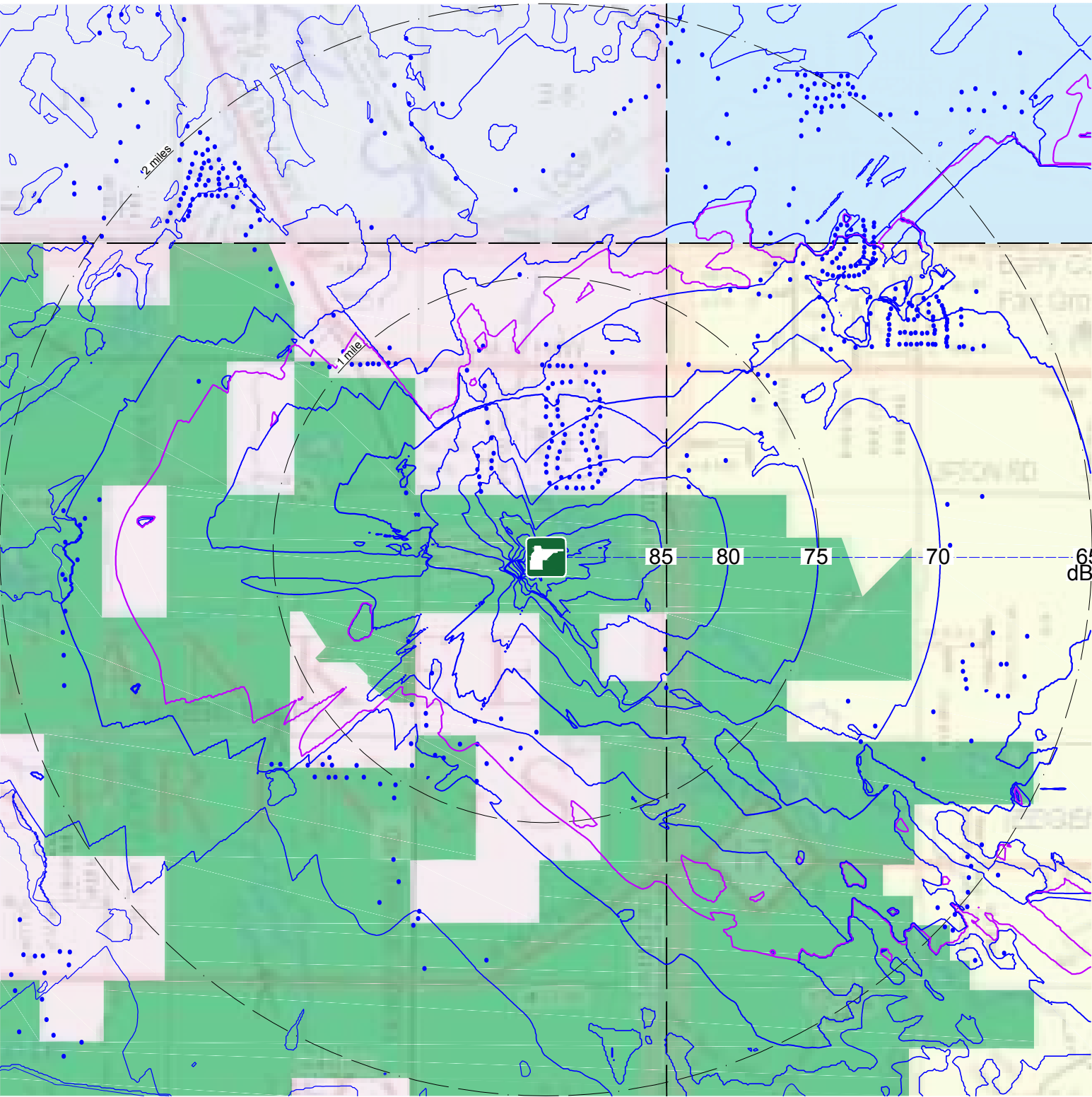
Computer model study 7 was conducted with sound absorbent material added to the underside of the ceiling and the partitions dividing the individual lanes. The models were run on Site 1: Barry State Game Area Existing Range Site with the direction of fire to the east and southwest with the typical day scenario and Site 2: Barry State Game Area Chief Noonday Site with the direction of fire to the south and southwest with the typical day scenario.

1. The “typical day” had 5 shooters firing a .223 caliber rifle on the 100 yard range; 1 shooter firing a .223 caliber rifle on the 150 yard range; 2 shooters firing a 12 gauge Remington shotgun on the 50 yard range; and 3 shooters firing a 0.40 caliber handgun on the 25 yard range within a 1 second time period.
2. The wind condition in the base model was modeled as downwind with 1 to 11 mph wind as in computer model studies 1 and 2.
3. The 50°F and 70% relative humidity condition was used in the models
4. A sound absorbent panel was installed on the sides and ceiling of each lane
5. The direction of fire was to the east and southwest for Site 1 and to the south and southwest for Site 2.
6. The berm height of 20 ft. was used in the reference model.
7. The sound levels shown on the noise contour maps are LA eq in dBA.

In Experiment 7, solid dividers are installed between each lane in the range building covering the firing line at Site 1: Barry SGA range oriented to the east and to the southwest and Site 2: Chief Noonday range oriented to the south and to the southwest with the 20 ft. tall downrange berms and the “typical day” scenario. A sound absorbent lining panel is added to the side walls and ceiling of each lane in the range building. This locates each shooter in a sound absorbent enclosure that reduces sound propagating out of the range building. The linear pressure score is reduced by approximately 86% for the Site 2: Chief Noonday range oriented to the southwest, by approximately 84% for the Site 2: Chief Noonday range oriented to the south, and by 52% for the Site 1: Barry SGA range oriented to the east. The rough order of magnitude cost for installing solid dividers in each of the lanes and lining the ceiling and walls of each lane with a weather-resistant sound absorbing panel such as Troy Board manufactured by Troy Acoustics is \$85,900.

Table L-1. Summary table of rating points for each scenario tested in Experiment 7.

| TYPICAL DAY 11 SHOOTERS 20 FT BERM | | | | |
|--------------------------------------|-----|-----------|----|------|
| Site | DOF | Lin Press | dB | PTS |
| SITE 2: Chief Noonday | SW | 1,312 | 81 | 1894 |
| SITE 2: Chief Noonday | S | 1,514 | 82 | 1459 |
| SITE 2: Chief Noonday Reference | S | 4,630 | 87 | 1785 |
| SITE 1: Barry SGA | E | 34,003 | 95 | 2496 |
| SITE 1: Barry SGA | SW | 44,885 | 97 | 2267 |
| SITE 1: Barry SGA Reference | E | 59,135 | 98 | 2140 |



BARRY SGA
Sound Absorbing Dividers + Underside of Canopy

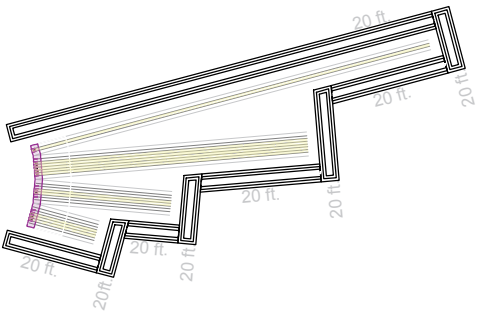
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

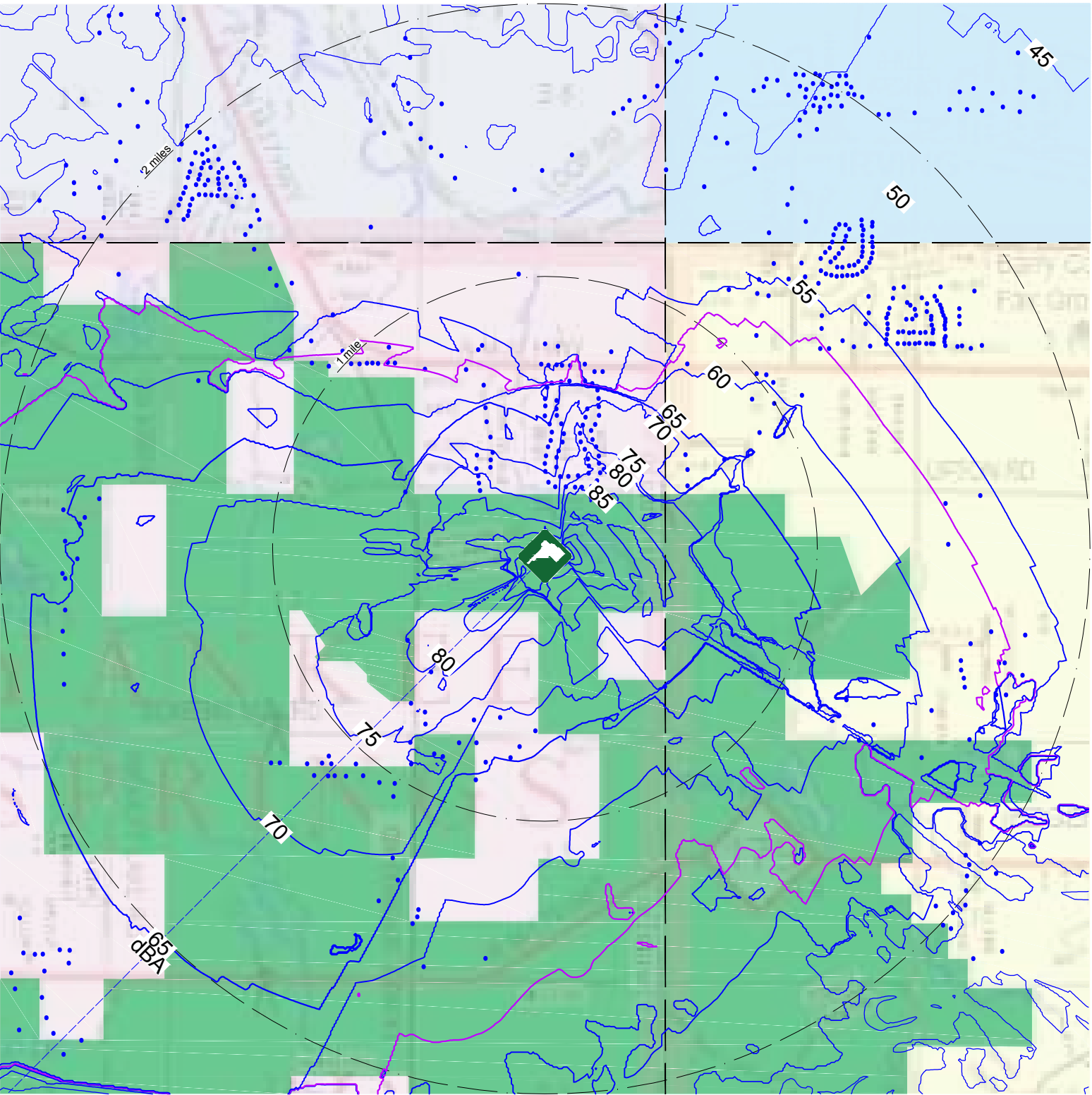
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure L-1
SA □ Siebein Associates, Inc.



BARRY SGA
Sound Absorbing Dividers + Underside of Canopy

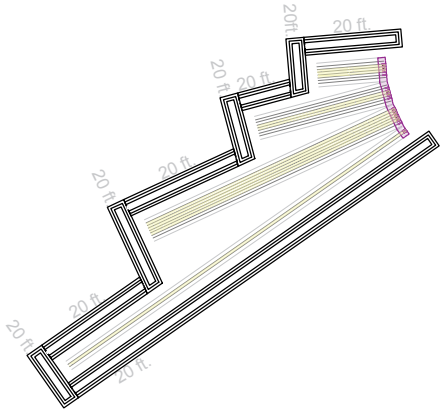
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. SW

20 ft. End Berms
20 ft. Side Berms

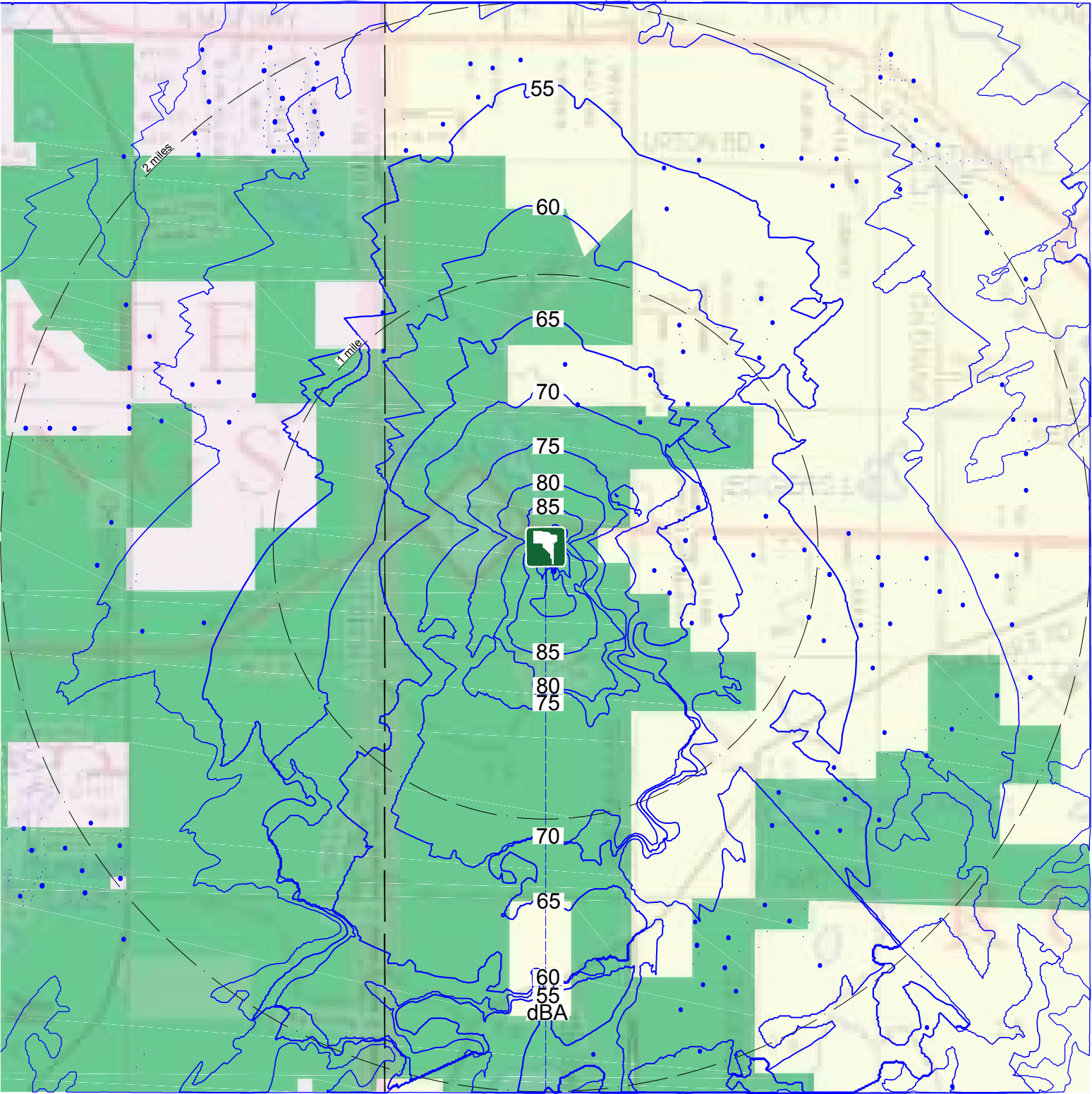
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure L-2
SA □ Siebein Associates, Inc.



CHIEF NOONDAY
Sound Absorbing Dividers + Underside of Canopy

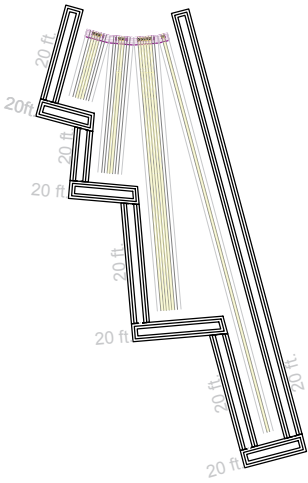
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. South

20 ft. End Berms
20 ft. Side Berms

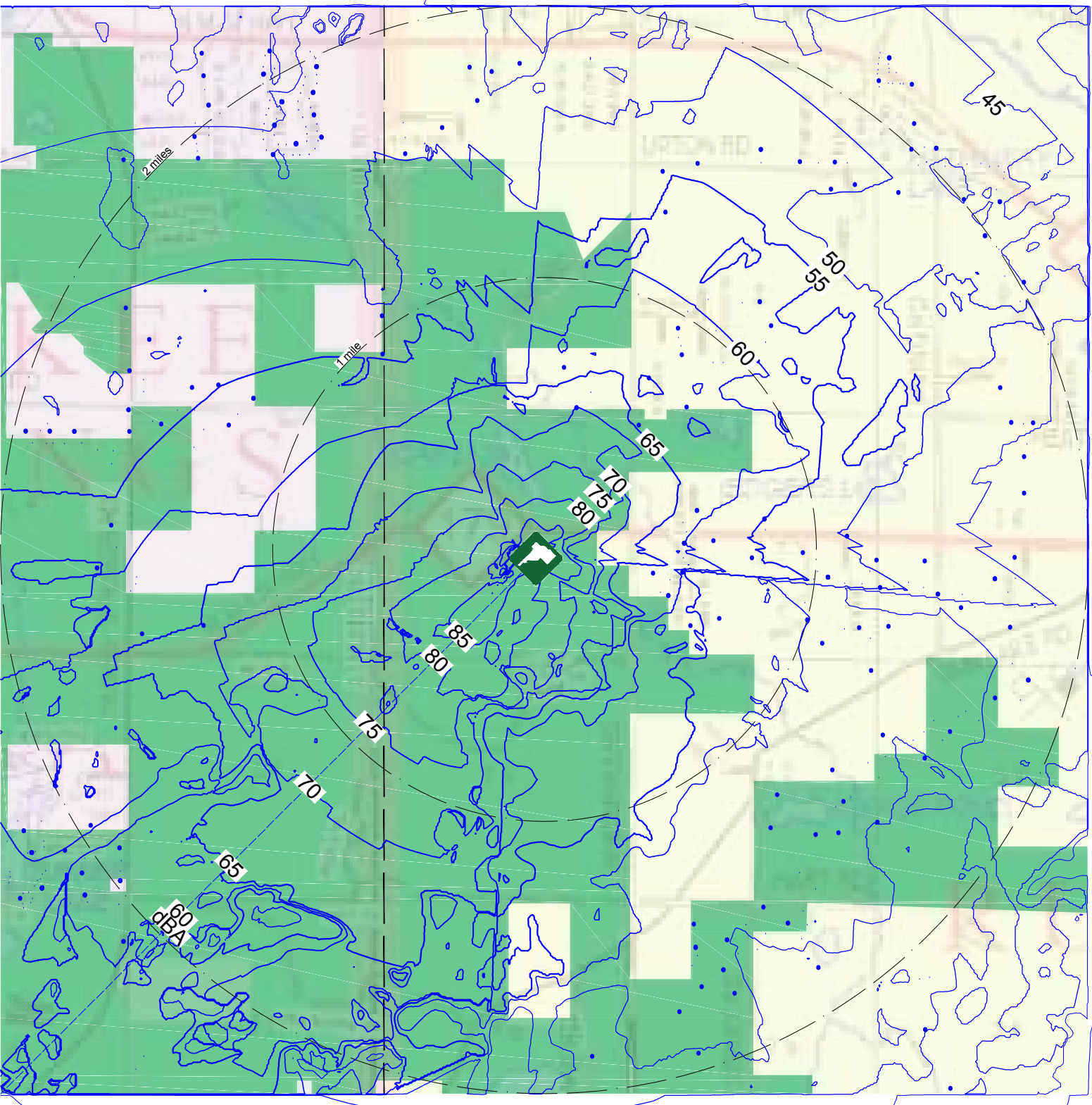
Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure L-3
SA □ Siebein Associates, Inc.



CHIEF NOONDAY
Sound Absorbing Dividers + Underside of Canopy

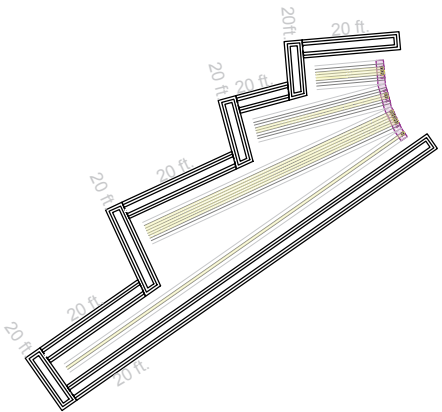
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. SW

20 ft. End Berms
20 ft. Side Berms

Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established

Figure L-4
SA □ Siebein Associates, Inc.

APPENDIX M: COMPUTER MODEL STUDY 8:

Side and Rear Walls Added to the Range Structure

Site 1 Alternate Range Orientation; Site 2 Base and Alternate Range Orientation

Typical Day Scenario

20 ft. tall berm

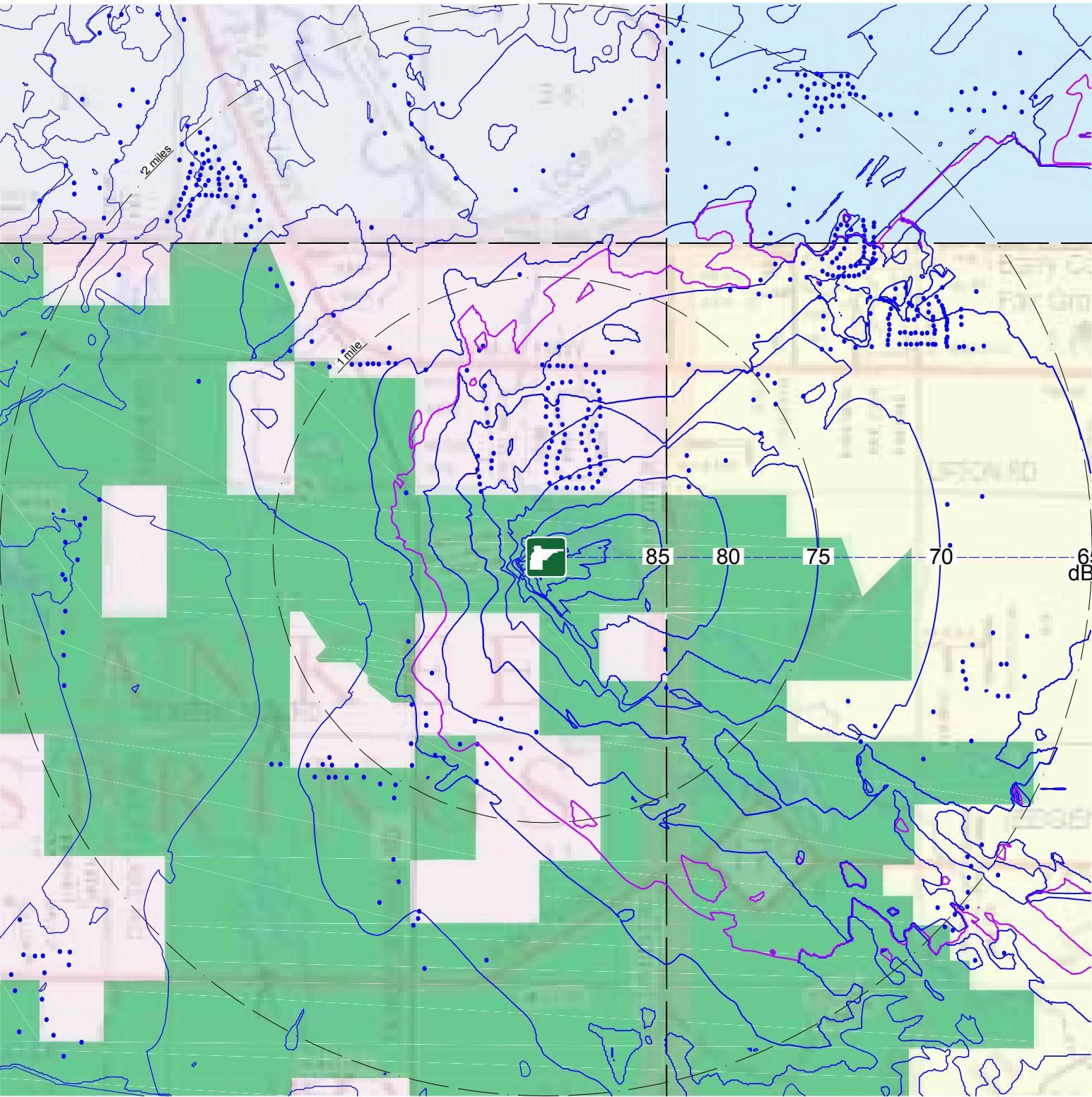
Computer model study 8 was conducted with side and rear walls added to the range structure so the firing positions were open only in the direction of fire. A sound absorbent material was added to the inside face of the side and rear walls as well as to the partitions dividing the individual lanes described in Computer Model Study 7. The models were run on Site 1: Barry State Game Area Existing Range Site with the direction of fire to the east and southwest with the typical day scenario and Site 2: Barry State Game Area Chief Noonday Site with the direction of fire to the south and southwest with the typical day scenario.

1. The “typical day” had 5 shooters firing a .223 caliber rifle on the 100 yard range; 1 shooter firing a .223 caliber rifle on the 150 yard range; 2 shooters firing a 12 gauge Remington shotgun on the 50 yard range; and 3 shooters firing a 0.40 caliber handgun on the 25 yard range within a 1 second time period.
2. The wind condition in the base model was modeled as downwind with 1 to 11 mph wind as in computer model studies 1 and 2.
3. The 50°F and 70% relative humidity condition was used in the models.
4. Side walls and a rear wall were added to the range structure so the range was only open in the direction of fire. Wood frame walls were built between each firing lane with plywood covering. A sound absorbent panel was installed on the sides and ceiling of each lane as well as on the side and rear walls of the entire range structure.
5. The direction of fire was to the east and southwest for Site 1 and to the south and southwest for Site 2.
6. The berm height of 20 ft. was used in the reference model.
7. The sound levels shown on the noise contour maps are LA eq in dBA.

In Experiment 8, solid side walls and a rear wall were added to the range building in addition to the solid dividers installed between each lane Site 1: Barry SGA range oriented to the east and to the southwest, and in Site 2: Chief Noonday range oriented to the south and southwest with the 20 ft. tall downrange berm and the “typical day” scenario in Experiment 7. A sound absorbent lining panel is added to the rear wall, side walls, interior lane dividing walls and the ceiling of each lane in the range building. This locates each shooter in a sound absorbent enclosure on 3 sides that reduces sound propagating out of the range building. The linear pressure score is reduced by approximately 91% for the Site 2: Chief Noonday range oriented to the southwest, by approximately 89% for the Site 2: Chief Noonday range oriented to the south, and by 81% for the Site 1: Barry SGA range oriented to the southwest. The rough order of magnitude cost for installing the side walls, rear wall, solid dividers in each of the lanes and lining the ceiling and walls of each lane with a weather-resistant sound absorbing panel such as Troy Board manufactured by Troy Acoustics is \$134,500.

Table M-1. Summary table of rating points for each scenario tested in Experiment 8.

| TYPICAL DAY 11 SHOOTERS 20 FT BERM | | | | |
|---|------------|------------------|-----------|------------|
| Site | DOF | Lin Press | dB | PTS |
| SITE 2: Chief Noonday | SW | 864 | 79 | 1643 |
| SITE 2: Chief Noonday | S | 1,064 | 80 | 1387 |
| SITE 2: Chief Noonday Reference | S | 4,630 | 87 | 1785 |
| SITE 1: Barry SGA | SW | 13,826 | 91 | 2085 |
| SITE 1: Barry SGA | E | 26,908 | 94 | 2023 |
| SITE 1: Barry SGA Reference | E | 59,135 | 98 | 2140 |



BARRY SGA
Sound Absorbing Dividers + Underside of Canopy
Rear and Side Walls Added

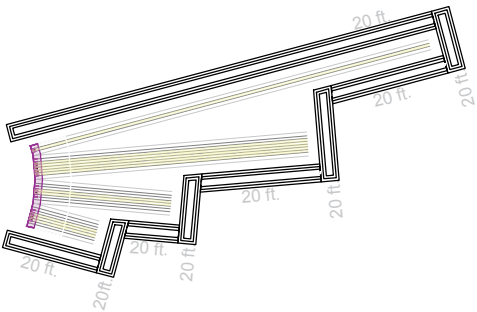
Shooters within 1 second:
6 Rifles
2 Shotguns
3 Handguns

D.O.F. East

20 ft. End Berms
20 ft. Side Berms

Wind: 1 to 11 mph downward

50°F and 70% R.H.



- STATE GAME AREA
- THORNAPPLE TOWNSHIP
No sound level limitations established
- IRVING TOWNSHIP
Refer to Barry County Zoning Ordinance
- 57 dBA Residential Zones
- 60 dBA Commercial
- 65 dBA Industrial
- YANKEE SPRINGS TOWNSHIP
No sound level limitations established
- RUTLAND TOWNSHIP
No sound level limitations established
- BARRY COUNTY ZONING ORDINANCE
Sound Level Limitations if site is zoned as Commercial

Figure M-1
SA □ Siebein Associates, Inc.